METHYL BROMIDE CRITICAL USE NOMINATION FOR PREPLANT SOIL USE FOR ORNAMENTALS GROWN IN OPEN FIELDS OR IN PROTECTED ENVIRONMENTS

FOR ADMINISTRATIVE PURPOSES ONLY: **DATE RECEIVED BY OZONE SECRETARIAT:** YEAR: CUN:

NOMINATING PARTY:	The United States of America
BRIEF DESCRIPTIVE TITLE OF NOMINATION:	Methyl Bromide Critical Use Nomination for Preplant Soil Use for Ornamentals Grown in Open Fields or in Protected Environments (Submitted in 2006 for Use in 2008)

NOMINATING PARTY CONTACT DETAILS

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Following the requirements of Decision IX/6 paragraph (a)(1), the United States of America has determined that the specific use detailed in this Critical Use Nomination is critical because the lack of availability of methyl bromide for this use would result in a significant market disruption.

☐ Yes ☐ No

Signature Name Date

Title:

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LIST OF DOCUMENTS SENT TO THE OZONE SECRETARIAT IN OFFICIAL NOMINATION PACKAGE

List all paper and electronic documents submitted by the Nominating Party to the Ozone Secretariat

1. PAPER DOCUMENTS: **Title of Paper Documents and Appendices**	**Number of Pages**	**Date Sent to Ozone Secretariat**

2. ELECTRONIC COPIES OF ALL PAPER DOCUMENTS: **Title of Electronic Files**	**Size of File (mb)**	**Date Sent to Ozone Secretariat**
CUN2008 USA Ornamental Photos 1-23-2006	2.15	

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PART A: SUMMARY

1. NOMINATING PARTY:

The United States of America (U.S.)

2. DESCRIPTIVE TITLE OF NOMINATION:

Methyl Bromide Critical Use Nomination for Preplant Soil Use for Cut Flower, Bulb, and Herbaceous Perennial Ornamentals Grown in Open Fields or in Protected Environments (Submitted in 2006 for Use in 2008)

3. CROP AND SUMMARY OF CROP SYSTEM:

In the United States cut flower, cut foliage and bulb crops are grown in open fields and under cover (including glass, poly, and saran). In 1997, eight percent of the ornamentals in the United States were grown under cover and 92 percent were grown in the open. There are three basic systems in place for ornamentals. Annuals are shallow rooted crops that represent 50 to 60 percent of the industry. They are often planted to a depth of 6 to 8 inches. Fumigants can be shanked into the preformed beds or drip-applied from drip tapes placed on top of beds under plastic mulch. Bulb crops represent about 30 percent of the industry. Fumigants are applied by deep shanking. Bedding up generally occurs after planting the bulbs. Perennials are deep-rooted multi-year crops and represent 10 to 20 percent of the industry in California. Fumigation needs to penetrate to a depth of 2 to 3 feet and may require multi-level shanking.

Methyl bromide is used in almost all saran house production – snap dragons, asters, gerbera daisies, mums, etc, as a broadcast solid tarp treatment. It is used in field grown statice and gypsophila as an in-bed treatment. In some gladiolus production, methyl bromide is used broadcast solid tarp for increased of cormels and tissue culture stock (Ragsdale, 2004).

This nomination is for multiple species (see Appendix B). Only a subset of the cropping systems will be explained. For Florida this will include caladiums and general cut flower production. In California, ranunculus will be used as an example. Herbaceous perennials in Michigan and Illinois will also be described. This industry changes rapidly and therefore, the species and varieties grown also changes. For example, several years ago, sunflowers were not a major crop in Florida but now they are.

Caladiums are grown in Florida on either sandy or muck soils. They are planted from the middle of March until mid April. Caladiums are dug annually from November until the middle of March. The tubers are cleaned, graded, repacked, and stored until shipment to customers throughout the world. Methyl bromide is applied in the short time period between the end of harvest of one crop and the planting of the next.

In Florida, some of the typical cut flowers grown are snapdragons, lilies, gladiolus, lisianthus, delphinium, and sunflowers. Growers rotate to other cut flower species, but not to other crops. Planting occurs between August and March, with harvesting occurring October through May. Two to three plantings occur each year, with only one application of methyl bromide each year.

Ranunculus are grown as annuals in the field. In fall, seeds are planted on beds. Flowers are harvested in the spring and the tubers are harvested in July and August. These tubers are used in landscaping and are planted in the fall (Elmore et al., 2003b). The tubers, which are distributed worldwide, are also used in commercial production.

Perennial herbaceous nurseries are also requesting methyl bromide and are included in this sector. Growers require methyl bromide to control nematodes and weeds. This industry has adopted alternative pest management strategies for a portion of the land, and they are conducting trials to assess the efficacy of alternatives.

Without methyl bromide, growers will suffer both yield and quality losses. There is a need to control previous planted varieties to eliminate contamination, as well as control other weeds and pathogens. Some of the alternatives that have been found for other crops are not feasible for some floriculture crops because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, and buffer zone requirements. In California, township caps limit the use of 1,3-D as an alternative. Although some alternatives have shown potential to replace methyl bromide use in some situations, the in-field feasibility of the alternatives for each of the major species of ornamentals grown in the United States remains to be demonstrated. The industry has made progress in reducing the use of methyl bromide and additional research is ongoing. Additional time is needed to complete the phase-out of methyl bromide in this sector due to the complexity of production (numerous species, each with its own pests and implementation issues) and the lack of scientifically proven alternatives.

4. METHYL BROMIDE NOMINATED:

TABLE 4.1: METHYL BROMIDE NOMINATED

YEAR	NOMINATION AMOUNT (KG)*	NOMINATION AREA (HA)
2008	**138,538**	**516**

* Includes research amount of 4,060 kgs.

5. BRIEF SUMMARY OF THE NEED FOR METHYL BROMIDE AS A CRITICAL USE:

The U.S nomination is only for those areas where the alternatives are not suitable. In U.S. ornamental production there are several factors that make the potential alternatives to methyl bromide unsuitable. These include:

- Pest control efficacy of alternatives: the efficacy of alternatives may not be comparable to methyl bromide in some areas, making these alternatives technically and/or economically infeasible for use in ornamental production.
- Key target pests: the U.S. is only nominating a CUE where the key pest pressure is moderate to high.
- Regulatory constraints: e.g., in some areas of the United States 1,3-Dichloropropene use is limited due to township caps in California.
- Delay in planting and harvesting: e.g., the plant-back interval for telone+chloropicrin is two weeks longer than methyl bromide+chloropicrin, and in the northern parts of the United States an additional delay would occur because soil temperature must be higher to fumigate with alternatives. Delays in planting and harvesting result in users missing key market windows, and adversely affect revenues through lower prices.

Overall, the ornamentals industry has hundreds of crop species and thousands of varieties. This diversity makes finding methyl bromide alternatives for each crop species complex, time consuming and costly (Schneider, 2003).

As part of the overall ornamentals industry, the cut flower, foliage, and bulb industry is very complex. For example, a single grower in California may grow as many as 100 species and/or varieties in a single year. Growers must find methyl bromide alternatives that will control previous crops grown on the site, as well as a diversity of key pests, which vary for each crop variety. For example, in ranunculus, residual tubers, bulbs, and seeds from the previous crop must be killed because they are reservoirs for nematodes and soil pathogens and considered to be weeds themselves as they are off-variety. Along with these issues, there are concerns about phytotoxicity and registration with alternative chemicals (Schneider, 2003; Elmore et al., 2003b). Recent experiences with iodomethane indicate that new chemistries can take several years to be registered by the U.S. EPA and the state regulatory agencies, such as California Department of Pesticide Regulation. In addition, township caps in California restrict the amount of 1,3-Dichloropropene that can be used in a given area (Trout, 2001). Buffer zones may also limit the adoption of alternatives.

TABLE A.1: EXECUTIVE SUMMARY

Region	*California*	*Florida*	*Michigan*
AMOUNT OF APPLICANT REQUEST			
2008 Kilograms	204,116	622,328	4,763
AMOUNT OF NOMINATION*			
2008 Kilograms	67,946	63,232	3,300

**See Appendix A for a complete description of how the nominated amount was calculated.*

6. SUMMARIZE WHY KEY ALTERNATIVES ARE NOT FEASIBLE:

In California, township caps for 1, 3-Dichloropropene limit the number of growers that are able to use 1,3-D + chloropicrin. Further, because the ornamentals industry is complex, time is needed to determine methyl bromide alternatives for all species and varieties grown, including determining whether there are any phytotoxicity issues from using methyl bromide alternatives (Schneider, 2003). Some of the alternatives that have been found for other crops are not feasible for floriculture because of their high cost, difficulties with quickly treating and replanting fields for multi-cropping, and/or buffer zone requirements (Elmore, 2003a). Ornamentals have a high value; as a result many manufacturers now avoid registering materials for ornamental crops because of liability due to potential phytotoxicity issues.

7. (*i*) PROPORTION OF CROPS GROWN USING METHYL BROMIDE

TABLE 7.1: PROPORTION OF CROPS GROWN USING METHYL BROMIDE

REGION WHERE METHYL BROMIDE USE IS REQUESTED	TOTAL CROP AREA (HA)	PROPORTION OF TOTAL CROP AREA TREATED WITH METHYL BROMIDE (%)
Ornamentals – California[1]	10,054	Not Available
Cut Flower and Foliage – FL[2]	7,111	Not Available
Caladium – FL[2]	642	Not Available
Michigan and Illinois - Floriculture Crops[3]	2662	<1
REGIONAL TOTAL:	17,807	Not available
NATIONAL TOTAL:	Not Available	Not Available

[1] 2000 California Department of Pesticide Regulation Data
[2] Based on information from experts in Florida
[3] USDA 2002 Census of Agriculture

7. (*ii*) IF ONLY PART OF THE CROP AREA IS TREATED WITH METHYL BROMIDE INDICATE THE REASON WHY METHYL BROMIDE IS NOT USED IN THE OTHER AREA AND IDENTIFY WHAT ALTERNATIVE STRATEGIES ARE USED TO CONTROL THE TARGET PATHOGENS AND WEEDS WITHOUT METHYL BROMIDE THERE.

Given the number and diversity of species grown in the industry, there are a number of reasons why methyl bromide is not used. Some crops have been able to switch to alternatives. For example, growers in Oregon are now using 1,3-Dichloropropene for Easter lilies. Also, some species may not need methyl bromide, depending on their key pests and the ability to use alternatives.

Growers are also maximizing their use of methyl bromide. Instead of fumigating after each crop (more than once a year), producers may grow several crops over 1 to 2 years on the same piece of land, using methyl bromide only when necessary instead of after every crop, and thus reducing the amount used. Cropping systems have been changed to allow most sensitive crops to be planted immediately following a fumigation followed by several other types of plants in decreasing sensitivity to soil pathogens. Costs of fumigation alone made this a critical change in cut flower production. In addition, some perennials may be grown for 5 to 25 years. Methyl bromide would only be used once during this cycle.

In this industry, the fumigation situation and need for methyl bromide varies by species. Although there are some potential alternatives, there is not enough scientific or grower experience for all crop species to switch to alternatives at this time. One major difficulty is that market desires require a high degree of flexibility in scheduling certain species and new cultivars. Therefore, the information on the sensitivity of each crop to fumigant alternatives as well as the pests is not known until crops have been in production for at least a few cycles.

7. (*iii*) WOULD IT BE FEASIBLE TO EXPAND THE USE OF THESE METHODS TO COVER AT LEAST PART OF THE CROP THAT HAS REQUESTED USE OF METHYL BROMIDE? WHAT CHANGES WOULD BE NECESSARY TO ENABLE THIS?

Not all of the above methods and alternatives being used are feasible for other crops. However, the industry is working to find alternatives to methyl bromide. New products will be incorporated into commercial practice as they become available.

Specifically, township caps in California limit the use of 1,3-Dichloropropene. Many of the crops are grown in coastal areas, where cut flowers are also grown. It is expected that about 30 percent of the 2000 fumigated cut flower acres could not have used 1,3-D at the current 2X cap, which is expected to apply through at least 2004. This number would be higher with the standard (1X) caps. Affecting some rotations are plant back times, which can be 1 to 2 weeks longer with 1,3-D. Combined regulatory and plant back limitations could restrict use of 1,3-D in California to less than 50 percent of the current fumigated area (Trout, 2003; Ragsdale, 2004). In addition, an alternative that works for one crop species may not control the key pests of another species or it could be phytotoxic to the other species. The industry needs additional time to complete ongoing research to find and implement alternatives for each species.

8. Amount of Methyl Bromide Requested for Critical Use

Ornamentals - Table 8.1: Amount of Methyl Bromide Requested for Critical Use

Region:	**California**	**Florida**	**Michigan**
Year of Exemption Request	**2008**	**2008**	**2008**
Kilograms of Methyl Bromide	204,116	622,328	4,763
Use: Flat Fumigation or Strip/Bed Treatment	Flat Fumigation	Flat Fumigation	Flat Fumigation
Formulation *(ratio of methyl bromide/Chloropicrin mixture)* to be used for the CUE	67:33	67:33	98:2
Total Area to be treated with the methyl bromide or methyl bromide/Chloropicrin formulation *(m^2 or ha)*	809	1,416	12
Application rate* *(kg/ha)* for the **Active Ingredient**	252	439	392
Dosage rate* *(kg/ha)* of **Active Ingredient** used to calculate requested kg of methyl bromide	25.2	43.9	39.2

9. Summarize Assumptions Used to Calculate Methyl Bromide Quantity Nominated for Each Region:

The amount of methyl bromide nominated by the U.S. was calculated as follows:

- The percent of regional hectares in the applicant's request was divided by the total area planted in that crop in the region covered by the request. Values greater than 100 percent are due to the inclusion of additional varieties in the applicant's request that were not included in the USDA National Agricultural Statistics Service surveys of the crop.
- Hectares counted in more than one application or rotated within one year of an application to a crop that also uses methyl bromide were subtracted. There was no double counting in this sector.
- Growth or increasing production (the amount of area requested by the applicant that is

greater than that historically treated) was subtracted. The applicants that included growth in their request had the growth amount removed.

- Only the hectares with one or more of the following impacts were included in the nominated amount: moderate to heavy key pest pressure, karst geology, unsuitable terrain, and cold soil temperatures.

CALIFORNIA ORNAMENTALS - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

CALIFORNIA ORNAMENTALS - 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

CALIFORNIA ORNAMENTALS - TABLE 10.1: KEY DISEASES AND WEEDS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY DISEASE(S) AND WEED(S) TO GENUS AND, IF KNOWN, TO SPECIES LEVEL	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
California	All soil borne diseases, weeds, and nematodes. Includes *Fusarium* spp., *Rhizoctonia* spp., *Phytoplithora*, Stromatinia, *Pythium* spp., and most soil nematodes i.e. *Meloidogyne* spp., and previous crop propagules. Specific pest problems vary by individual crop and variety. See Appendix C for more detailed information.	Due to the diversity and complexity of the cut flower and foliage industry, additional time is needed to complete ongoing research into implementation of methyl bromide alternatives and to allow time for registering materials. Alternatives have not been found for all species. Some of the alternatives that have been found for other crops may not be feasible for floriculture because of high cost, phytotoxicity issues, difficulties with quickly treating and replanting fields for multi-cropping, township caps, and buffer zone requirements (Elmore et al., 2003a).

CALIFORNIA ORNAMENTALS - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

CALIFORNIA ORNAMENTALS - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	ORNAMENTALS
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Cuttings, bulbs
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual and perennial
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	A California cut flower producer may grow more than 20 ornamental species and hundreds of individual varieties. Crops are grown in rotation on an 8 to 16 week interval per year on the same parcel of land. Although species are rotated, the complex nature of this crop makes a *typical* crop rotation difficult to identify. Instead, an example of a rotation will be described here. A crop rotation system for a grower may involve several annuals. The first annual crop is planted and harvested 90 to 180 days later. A different species is planted immediately after the first harvest. Harvest follows approximately 90 to 180 days later. A third crop is then planted. Fumigation would occur when the production starts to decline, which may be an interval of one to two years. Most growers produce numerous species, including annuals, perennials, and bulbs, throughout the farm. The rotation involving all of these species would be more complex than the example above.
SOIL TYPES: *(Sand, loam, clay, etc.)*	All. Cut flowers in California are primarily produced in the coastal environment where nearly all types of soil are present.
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	In general, once every year although it may occur less often on a substantial portion of the acreage in this sector that produce perennials and gladiolus.
OTHER RELEVANT FACTORS:	None identified.

Tables 11.2, 11.3, and 11.4 are examples of the characteristics of climate and crop schedule for cut flowers, foliage and bulbs planted in the fall and in the spring, and ranunculus. These characteristics may vary for different species.

CALIFORNIA ORNAMENTALS - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – FALL PLANTINGS

	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
CLIMATIC ZONE	9a – 11 Plant hardiness zone.											
RAINFALL *(mm)**	0	Trace	1.0	Trace	0	44.7	56.9	9.9	30.5	16.0	72.1	17.3
OUTSIDE TEMP. *(℃)**	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6	14.4	14.8	20.8
LAND PREPARATION	X	X	X	X	X							
FUMIGATION SCHEDULE		X	X	X	X							
PLANTING SCHEDULE		X	X	X	X							
HARVEST SCHEDULE								X	X	X	X	X

*Data for Jan-Aug, 2003 and Sep-Dec 2002 for Fresno, California.

CALIFORNIA ORNAMENTALS - TABLE 11.3 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – SPRING PLANTINGS

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	9a – 11 Plant hardiness zone.											
RAINFALL *(mm)**	16.0	72.1	17.3	0	Trace	1.0	Trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)**	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
LAND PREPARATION	X											
FUMIGATION SCHEDULE	X	X										
PLANTING SCHEDULE		X	X	X	X							
HARVESTING SCHEDULE				X	X	X	X	X				

*Data for Jan-Aug, 2003 and Sep-Dec 2002 for Fresno, California.

CALIFORNIA ORNAMENTALS - TABLE 11.4 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – RANUNCULUS

The ranunculus crop is different from other cut flower, foliage, and bulb crops because they have two planting sequences to ensure long season availability of the product. The first sequence occurs on a very small percent of the acreage and used only to produce cut flowers. It begins with land preparation in May followed by fumigation in June. Planting occurs in June and July and flowers are harvested from September through February. The main planting is used to produce both cut flowers and bulbs. Land preparation occurs in August followed by fumigation in September and October. Planting occurs from September through December with harvesting of cut flowers occurring from February through May (possibly into June in some years).

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	9a – 11 Plant hardiness zone.											
RAINFALL *(mm)**	16.0	72.1	17.3	0	Trace	1.0	Trace	0	44.7	56.9	9.9	30.5
OUTSIDE TEMP. *(℃)**	14.4	14.8	20.8	25.7	30.3	27.4	25.1	18.4	13.4	9.6	10.3	10.6
FUMIGATION SCHEDULE				X		Land prep	X	X				
PLANTING SCHEDULE					X (very small area)		X	X	X	X		
KEY MARKET WINDOW	X	X	X	X			X	X	X	X	X	X

*Data for Jan-Aug, 2003 and Sep-Dec 2002 for Fresno, California.

Tables 11.5 and 11.6 provide examples of potential scenarios involving multi-crop rotations after a single methyl bromide fumigation. There are other crop species that could also be planted. These crops are often susceptible to the same pests.

CALIFORNIA ORNAMENTALS - TABLE 11.5 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – MULTIPLE CROP ROTATION SCENARIO ONE

	WIN 1	SPR 1	SUM 1	AUT 1	WIN 2	SPR 2	SUM 2	AUT 2	WIN 3	SPR 3	SUM 3	AUT 3
CHRYSANTHEMUMS			X	X	X							
IRIS (DUTCH)					X	X						
LIATRIS						X	X					
HYPERICUM							X	X	X	X	X	(continuing until summer 5)

Win = winter, spr = spring, sum = summer, aut = autumn

CALIFORNIA ORNAMENTALS - TABLE 11.6 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – MULTIPLE CROP ROTATION SCENARIO TWO

	WIN 1	SPR 1	SUM 1	AUT 1	WIN 2	SPR 2	SUM 2	AUT 2	WIN 3	SPR 3	SUM 3	AUT 3
RANUNCULUS			X	X	X							
STOCK					X	X	X					
IRIS (DUTCH)								X	X			
LIATRIS									X	X	X	

Win = winter, spr = spring, sum = summer, aut = autumn

In one study, the schedule for liatris was fumigation in November, planting in December, and harvest in April (Gerik, 2005a).

It is difficult to determine acreage information for cut flowers. However, production data for the major cut flower and bulb species grown is available (See Table 11.5) and estimates of the acreage have been made (See Table 11.6).

CALIFORNIA ORNAMENTALS - TABLE 11.6 PRODUCTION OF MAJOR SPECIES

SPECIES	# FLOWER BUNCHES IN 2003
Alstroemeria	892,789
Carnations	1,694,870
Delphinium	3,617,186
Gladiolus	Data not released
Gerbera	62,638,650
Iris	5,823,242
Lilium	6,247,027
Chrysanthemums	1,273,742
Pompons	6,350,127
Roses	7,360,729
Snapdragons	2,976,219

Source: *Prince & Prince, Inc. Survey*, 2003
This survey is the only source of information but may under report data. Also, the number of stems/bunch is not the same for all crops.

CALIFORNIA ORNAMENTALS - TABLE 11.7 PARTIAL LISTING AND ESTIMATE OF CUT FLOWER AND FOLIAGE AREA PRODUCED IN CALIFORNIA IN 2002

CROP	AREA (USUALLY FIELD) - HA	AREA (USUALLY GREENHOUSE) – M^2
Alstroemeria	8 (0.3%)	47,100 (3.2 %)
Antirrhinum (snapdragon)	126 (5%)	164,898 (11.3%)
Aster		57,598 (4%)
Calla lily	16 (0.6%)	
Carnation	30 (1.2%)	21,739 (1.5%)
Chrysanthemum	88 (3.3%)	281,023 (19 %)
Delphinium	22 (0.8%)	
Eucalyptus	54 (2%)	
Gerbera		214,413 (14.7%)
Gypsophila	55 (2%)	
Iris (Dutch)	18 (0.7%)	
Larkspur	6 (0.2%)	
Lilium	32 (1.2%)	205,959 (14.2%)
Limonium spp.	13 (0.5%)	
Lisianthus	13 (0.5%)	
Protea	190 (7.3%)	
Rose	41 (1.6% - all greenhouse)	123,557 (8.5%)
Stock (*Matthiola*)	26 (1%)	
Wax flower	317 (12%)	
Other	791 (30%)	59,177 (4%)
Greenhouse misc.	70 (2.7%)	278,700 (19%)
Field misc.	303 (11.6%)	
Cut greens misc.	389 (15%)	
Total	2609	1,454,164 (145 ha)

CALIFORNIA ORNAMENTALS – 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Cut flowers are often marketed for a certain time of year or holiday. Missing specific dates can be detrimental to the grower.

CALIFORNIA ORNAMENTALS - 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

CALIFORNIA ORNAMENTALS - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	552	576	332	364	281	Not Available
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	163,506	157,401	85,211	65,079	70,813	Not Available
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	67:33; 98:2	67:33; 98:2	67:33; 98:2	67:33; 98:2	67:33; 98:2	67:33; 98:2
METHOD BY WHICH METHYL BROMIDE APPLIED	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked
APPLICATION RATE OF ACTIVE INGREDIENT IN kg/ha*	296	273	256	179	252	Not Available
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)**	29.6	27.3	25.6	17.9	25.2	Not Available

The application rate includes both outdoor and greenhouse use. The outdoor use rate is lower than the greenhouse rate. For example, in 2002 the outdoor use rate was 178 kg/ha and the greenhouse rate was 318 kg/ha.

Growers are expected to use a 67:33 formulation in the future, although this may vary depending on the crop grown and the pest situation. The 50:50 formulation is not feasible because adequate control of weeds cannot be achieved.

CALIFORNIA ORNAMENTALS - PART C: TECHNICAL VALIDATION

CALIFORNIA ORNAMENTALS - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

CALIFORNIA ORNAMENTALS – TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-Dichloropropene	1,3-D is not very efficacious on its own for weed and disease control. Buffer zones make using this alternative difficult because flowers are often produced on small parcels of land, often near homes. 1,3-D cannot be used in greenhouses. Township caps are in place for 1,3-D that limit its use in California. Many of the crops are grown in coastal areas, where cut flowers are also grown. It is expected that about 30 percent of the 2000 fumigated cut flower acres could not have used 1,3-D at the current 2X cap, which is expected to apply through at least 2004. This number would be higher with the standard (1X) caps. Affecting some rotations are plant back times, which can be 1 to 2 weeks longer with 1,3-D. Combined regulatory and plant back limitations could restrict use of 1,3-D in California to less than 50 percent of the current fumigated area (Trout, 2003; Ragsdale, 2004).	No.
Metam sodium	Performance with metam sodium is erratic and inconsistent, depending on soil type, moisture content, and temperature. Many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Also, pest populations tend to build up over time with metam sodium. Repeat use results in an increase in the population of bio-degraders of the active ingredient. Problematic for bulb growers is the fact that it suppresses active nematodes, and not the eggs. Buffer zones make using this alternative difficult because flowers are produced on small parcels of land. Also, this alternative is not labeled for greenhouse use in California. In addition, the plant back restrictions may cause some growers to be able to grow fewer crops in a year. This fumigant is currently used and will continue to be used where it gives adequate pest control. In some cases it is used to suppress pest populations between methyl bromide treatments. While this reduces the number of times methyl bromide must be applied, it does not eliminate the need for methyl bromide. It is unlikely that metam sodium will replace significant portions of the current use of methyl bromide.	No

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
Dazomet (Basamid)	In some cut flowers (carnation and chrysanthemum) dazomet was effective against *Fusarium*, *Rhizoctonia*, *Erwinia*, and *Pseudomonas.* Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year.	No.
Chloropicrin	Chloropicrin may not currently be used in greenhouses in California. In California, buffer zones vary with county and condition in California. Buffer zones of 30 meters in sensitive areas make using this alternative difficult because flowers are produced on small parcels of land. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. Several California counties impose large buffers (>152 meters) and restrict rates to less than 224 kg/ha. Weed control is also poorer than with methyl bromide (Ragsdale, 2004). Adequate efficacy for the pest complex cannot be achieved with lower use rates.	No.
MITC	Same issues described above for metam sodium and dazomet.	No.
NON CHEMICAL ALTERNATIVES		
Biofumigation	Biofumigation is still largely in the experimental stages. (Pizano, 2001). Specific brassicas as well as specific years yield variable amounts of activity. While this alternative may provide some control, the control of all target pests is not sufficient. Also, brassica waste must be available in huge quantities to provide at best minor effects. The extremely large volume of raw material required makes this impractical.	No.
Solarization	Solarization takes several weeks to control many pests to a depth of 30 cm. This length of time for a treatment is not economically feasible in the intensive, year-round production situation of the cut flower industry (Pizano, 2001). Production areas in California are mainly coastal where solarization is not feasible due to cool temperatures and cloud cover most of the year.	No.
Steam	Steam can be a technically effective alternative in some cases. Reasons cited for not using steam for this crop system are high initial cost and high application costs limit widespread use. Some greenhouse growers have adapted this approach already in crops where it works better (such as Freesia). In-field steaming is not a feasible alternative due to lack of machinery that can deliver the steam, differences in soil type, and environmental impact of fuel use.	No.

NAME OF ALTERNATIVE	**TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE**	**IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?**
Biological control	Results with biological control agents may vary with field or environmental conditions (Pizano, 2001). Even in small containers, biological control is not reliable for soil-borne pathogens.	No.
Crop residue compost/Crop rotation/fallow	Rotation with other cut flower species is used extensively in cut flower production. However, in annual cropping they are generally too short for the full effects of rotating schemes to be effective. The previous crop (bulbs, corms) often contaminate the following crop or may harbor pathogens. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001). Most cut flower species are sensitive to the same pathogens. Flower rotations are generally not a true rotation in the pest control sense. Some growers have had success with crop rotation. In California, some gladiolus growers are leasing land to strawberry growers. The strawberry growers fumigate the land with methyl bromide, and a crop of gladiolus can follow without additional methyl bromide fumigation. This practice is most feasible for large growers and requires flexibility. This arrangement is not feasible for calla lily growers because calla lilies are very susceptible to the root disease complex supported by strawberries and raspberries.	No.
Flooding and water management	Beds are generally designed and graded for good drainage to prevent standing water. Flooding could increase the incidence of certain diseases and is also time restrictive. Environmental laws prohibit run-off in most of the state of California making use (and often access) to water in this manner impossible.	No.
General IPM	Although IPM is currently practiced, this alone will not control weed and disease pests.	No.
Grafting/resistant rootstock/plant breeding	Grafting/resistant rootstock/plant breeding are not feasible alternatives. Given the thousands of varieties of ornamentals, plant breeding for the variety of pests is not practical.	No.
Organic amendments/compost	Not effective alone in weed or pest management; may be incorporated as part of an IPM program. Does not provide adequate weed and disease control.	No.
Physical removal/sanitation	Appropriate sanitation practices are already used extensively. Also, a recent law banning hand weeding restricts the use of this practice in California.	No.
Resistant cultivars	Given the thousands of varieties of ornamentals, developing resistant cultivars for each variety, each with unique pest problems, is not practical. Choices are often market driven.	No.
Soilless culture / Substrates /plug plants	Container production may be possible in higher value cut flower crops but it is not generally feasible, especially for deeper rooted crops and on large acreage.	No.
COMBINATIONS OF ALTERNATIVES		

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
1,3-Dichloropropene + chloropicrin	In California, 1,3-D use is limited by township caps, buffer zones, and plant back times, which could affect some rotations. 1,3-D cannot be used in greenhouses. In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. In Florida, 1,3-D + chloropicrin, followed by metam sodium a week later, has shown control of diseases and nematodes, but does not adequately control weeds. However, consistent efficacy has not been seen in California.	No.
1,3-Dichloropropene + chloropicrin + pebulate	Pebulate is currently not registered. In California, 1,3-D use is limited by township caps, buffer zones, and plant back times, which could affect some rotations. 1,3-D cannot be used in greenhouses. In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.
Dazomet (Basamid) + chloropicrin	In some cut flowers (carnation and chrysanthemum) dazomet was effective against *Fusarium*, *Rhizoctonia*, *Erwinia*, and *Pseudomonas.* Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year. In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Metam sodium + chloropicrin	In California, limitations to metam sodium include buffer zones, greenhouse uses are not labeled, and plant back restrictions. In addition, many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Good disease control can be provided by chloropicrin. In California, limitations to chloropicrin include buffer zones, poorer weed control than methyl bromide, and that it may not currently be used in greenhouses. There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. In general, weed and nematode control is not adequate with this combination. In addition, these chemicals would have to be applied separately, requiring two applications.	No.
Metam sodium + crop rotation	In California, limitations to metam sodium include buffer zones, greenhouse uses are not labeled, and plant back restrictions. In addition, many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Rotation would be to other flower crops. In annual cropping they are generally too short for the full effects of rotating schemes to be effective. The previous crop (bulbs, corms) often contaminate the following crop or may harbor pathogens. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001). Instead of applying methyl bromide several times per year, some growers are rotating to less sensitive crops and treating with metam sodium to keep pest pressures low. However, eventually methyl bromide needs to be applied again or pest pressures will become too high. In California, some gladiolus growers are leasing land to strawberry growers. The strawberry growers fumigate the land with methyl bromide, and a crop of gladiolus can follow without additional methyl bromide fumigation. This arrangement is not feasible for calla lily growers because calla lilies are very susceptible to the root disease complex supported by strawberries and raspberries. Complicating crop rotation is the high number of crop species and varieties, with uncertainties as to their susceptibilities to nematodes and diseases.	No.

** Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.*

CALIFORNIA ORNAMENTALS - 14. LIST AND DISCUSS WHY REGISTERED *(and Potential)* PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE:

CALIFORNIA ORNAMENTALS – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
Herbicides and fumigation with methyl bromide, 1,3-D and chloropicrin, metam sodium and chloropicrin	Herbicides are more feasible for perennials if they are registered. The short time interval between crops (a crop cycle may only last 90 days) often restricts the use of herbicides due to replant intervals or phytotoxicity. Also, herbicides are often selective and there are a limited number registered. There are liability concerns due to phytotoxicity concerns on ornamentals.
Sodium azide	Preliminary results in a calla trial suggest that sodium azide may not be a feasible alternative in this crop due to reduced crop vigor and increased mortality (Gerik, 2003).

CALIFORNIA ORNAMENTALS - 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

CALIFORNIA ORNAMENTALS – TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Sodium azide	Not registered	Registration package not submitted	Unknown
Propargyl bromide	Not registered	Registration package not submitted	Unknown
Iodomethane	Not registered	Yes	Unknown
Furfural	Not registered	Yes	Unknown
Muscador albus strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

CALIFORNIA ORNAMENTALS - 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED

For additional studies on ornamentals, see data included for Florida. These studies were separated by location of the study, but some of the crop species, pests, and other issues are the same.

Evaluation of Soil Fumigants Applied by Drip Irrigation for Liatris Production (Gerik, 2005a):

In this study, all fumigants were applied through drip irrigation tapes and high-density polyethylene was used. A methyl bromide + chloropicrin comparison was not used because the plots were too small to use a shank application. See Table 16.1 for the 2003 results. Some data from the study, including 2002 data, are not included in the table.

Near harvest, there was no significant difference in the percent weed cover in all treatments, although weed control was not considered adequate. In addition, the number of inflorescences was not significantly different among the treatments, although longer stems were observed with some treatments. The results for weed control with drip-applied alternatives are consistent with preliminary results from another study (see Ajwa, 2005).

ORNAMENTALS – LIATRIS - TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – DISEASES AND WEEDS

KEY PEST: DISEASES AND WEEDS	AVERAGE DISEASE OR WEED % OR RATING AND YIELDS IN 2003					
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF REPS	DISEASE CONTROL (CFU/G DRY SOIL)		WEED CONTROL (MEAN # WEEDS/M^2)	LIATRIS PLANT VIGOR	LIATRIS AVG HEIGHT
		Pythium ultimum	***Fusarium oxysporum***	Total Weeds	RATING 1-5	CM
Iodomethane (213 kg/ha) + chloropicrin (213 kg/ha)	6	0	1,113	78	3.8	93
Metham sodium (356 kg/ha)	6	5	1,160	90	3.1	92
Chloropicrin (355 kg/ha), followed by metham sodium (356 kg/ha)	6	1	1,217	50	3.1	93
1,3-Dichloropropene (153 kg/ha) + chloropicrin (83.6 kg/ha)	6	8	1,205	109	3.4	92
1,3-Dichloropropene (153 kg/ha) + chloropicrin (83.6 kg/ha), followed by metham sodium (178kg/ha)	6	7	1,559	112	3.9	93
1,3-Dichloropropene (153 kg/ha) + chloropicrin (83.6 kg/ha), followed by metham sodium (356 kg/ha)	6	21	1,420	172	3.9	96
Sodium azide (112 kg/ha)	6	40	1,900	139	3.8	95
Furfural (674 kg/ha)	6	53	775	128	3.0	86
Fufural (337 kg/ha) + metham sodium (337 kg/ha)	6	2	749	219	3.7	91
DMDS (473 kg/ha)	6	57	620	95	3.1	89
DMDS (237 kg/ha) + chloropicrin ()237 kg/ha)	6	34	1,489	154	3.3	93
Untreated control	6	59	562	78	3.0	88
LSD		37	ns	ns	0.6	4

Gerik, 2005a

Methyl Bromide Alternatives Research and Education for California Cut Flowers (Ajwa and Elmore, 2005):

Trials were conducted in Carlsbad, California with the crop *Ranunculus* during the 2004 production season. The treatments included: an untreated control; and untreated control followed by metam sodium 350.625 L/ha; InLine (1,3-D/chloropicrin) 224 kg/ha; InLine (1,3-D/chloropicrin) 224 kg/ha followed by metam sodium 350.625 L/ha; Pic (chloropicrin) 224 kg/ha; Pic (chloropicrin) 224 kg/ha followed by metam sodium 350.625 L/ha; Midas 33/67 (iodomethane/chloropicrin) 224 kg/ha; and Midas 33/67 (iodomethane/chloropicrin) 224 kg/ha followed by metam sodium 350.625 L/ha. There were four replicates for each treatment and all treatments were drip applied. For weeds, there was high variability between replicates and no significant difference between treatments. In addition, there was no significant difference in hand weeding time. Bulbs from a previous *Ranunculus* crop were not controlled by the treatments. The control actually had fewer residual *Ranunculus* bulbs compared to the alternatives, which may be due to pathogen pressure in the control plots controlling the residual bulbs. Diseases, including Fusarium in sachets and in the soil, and Pythiaceous fungi, were controlled with all treatments except the control. The addition of metam sodium likely improved control of *Trichoderma* across all treatments. Crop vigor, flower yield, and bulb yield were significantly better across all treatments compared to the control.

In addition, 2005 trials include all of the treatments described above plus drip applied methyl bromide/chloropicrin and all treatments were split between HDPE and VIF mulch. Another trial also compared methyl bromide/chloropicrin and Midas (iodomethane/chloropicrin) shank applied using HDPE and VIF mulch. In a different location, a trial with callas was conducted using broadcast applied methyl bromide/chloropicrin and Midas (iodomethane/chloropicrin) under HDPE and VIF mulch. These fumigations will be followed by applications of furfural, dimethyl disulfide, iodomethane, and 2-bromo ethanol. Drip applied fumigation trials were also started at this location. The results are expected in the future.

Preliminary results are available from phytotoxicity greenhouse trials conducted on callas. Iodomethane was applied post-plant to three varieties of calla at the following rates: 0, 25, 50, 75, 100, and 200 mg/L. The callas were planted in pots containing 3 kg soil. Generally, injury from the treatments was not observed or was minor and inconsistent across replicates. At iodomethane rates of 75 mg/L and above, the callas were smaller compared to the control. However, by 27 days after treatment, the differences were negligible. In addition, bulb yield was not affected in terms of weight and size up to a concentration of 100 mg/L. These trials are ongoing.

Preliminary Weeding Data from Ajwa MBr Alts Experiment at Silverlake Ranch in Soledad CA. (Ajwa, 2005):
Preliminary results from this study indicate that drip-applied fumigants do not provide adequate weed control in calla lily production compared to broadcast-applied fumigants. The treatments evaluated were an untreated control, methyl bromide/chloropicrin 67:33, iodomethane/chloropicrin, chloropicrin, and 1,3-dichloropropene/chloropicrin (Inline®). Each treatment was tested with and without the addition of metam-potassium and with either standard or VIF tarp. There were six replications.

Preplant Pest Management in Ranunculus Production (Elmore et al., 2003b): Results from this study do not compare most of the alternatives to methyl bromide because most of the alternatives were used in higher moisture fields and methyl bromide was used in lower moisture fields. In lower moisture areas, the plots were treated with methyl bromide/chloropicrin or iodomethane/chloropicrin. In the higher moisture areas, the plots were treated with dazomet or metam sodium. In addition, these treatments were followed with either Telone C-35 or 1,3-D plus chloropicrin. Controls were used in both the low and high moisture areas. Other treatments included drip applied metam sodium, iodomethane/chloropicrin, chloropicrin, sodium azide, or 1-3-D +chloropicrin, but yield results are not available. In all studies there were no statistical differences between treatments in either weed pressure or yield among the alternatives. In the lower moisture treatments, there was a 34 percent yield loss between methyl bromide and the untreated control. See Table 16.2 below for more detail. The lack of differences in the treatments is likely due to the lack of pest pressure in the higher moisture fields. The higher moisture fields needed for certain alternatives were only available in areas not previously planted to ranunculus, and therefore there was not a buildup of pest pressure over time (Mellano, 2003).

ORNAMENTALS – RANUNCULUS - TABLE 16.2: EFFECTIVENESS OF ALTERNATIVES – WEEDS

KEY PEST: WEEDS	**AVERAGE DISEASE % OR RATING AND YIELDS IN PAST 3~5 YEARS**				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	**# OF REPS**	**WEED CONTROL (WEED COUNTS PER 5 SQUARE FEET)**		**# OF REPS**	**ACTUAL YIELDS (TOTAL BUNCHES)**
Lower moisture areas		**Malva**	**Clover**		
Methyl bromide/chloropicrin (50:50) 358 kg/ha	4	0.8 b	55.5	4	431.8 a
Iodomethane/chlorpicrin (50:50) 336 kg/ha	4	0.5 b	61.1	4	457.6 a
Iodomethane/chloropicrin (50:50) 392 kg/ha	4	0.5 b	43.6	4	426.5 a
Untreated – tarped	4	2.1 a	62.5	4	287.0 b
Higher moisture areas					
Metam sodium + Telone C-35 358 kg/ha + 327 L/ha	4	2.0 b	6.2	4	353.2
Metam sodium + 1,3-D + chloropicrin 358 kg/ha + 140 L/ha + 224 kg/ha	4	2.1 b	4.5	4	357.0
Metam sodium 358 kg/ha	4	3.1 b	3.2	4	357.3
Dazomet + Telone C-35 224 kg/ha + 327 L/ha	4	2.8 b	6.1	4	358.3
Dazomet + 1,3-D + chloropicrin 224 kg/ha + 140 L/ha + 224 kg/ha	4	2.1 b	5.5	4	332.5
Untreated – tarped	4	7.8 a	6.8	4	348.3

Elmore et al., 2003b

Evaluation of Alternatives to Methyl Bromide for Floriculture Crops (Gerik, 2003 and 2004): In Trial 1, the following chemical treatments were evaluated: untreated control; sodium azide (112 kg ai/ha); furfural 50% + metam sodium 50% (672 kg ai/ha); 1,3-dichloropropene (272 kg/ha); 1,3-dichloropropene 65% + chloropicrin 35% (627 kg/ha); iodomethane 50% + chloropicrin 50% (336 kg/ha); iodomethane 33% + chloropicrin 66% (448 kg/ha); chloropicrin (448 kg/ha). Drip applications were used in all treatments. Sachets with malva and mustard seed, and nutsedge and calla rhizomes were buried in the plots before treatment to evaluate weed control efficacy. None of the treatments killed the malva seeds. Chloropicrin controlled the nutsedge and calla rhizomes. Mustard seed, *Pythium* spp. and *Fusarium oxysporum* were controlled or reduced by all treatments compared to the untreated control, in addition to overall weed emergence. Sodium azide was the only chemical treatment that did not reduce *Phytophthora* spp. populations and resulted in reduced crop vigor and mortality in the planted calla. The following factors were all increased across all treatments, except sodium azide, compared to the control: number of flowers per plot, plant height, the number of total bulbs, and number of salable bulbs.

In Trial 3, the following treatments were evaluated: 1) untreated control; 2) Multiguard Protect/Metham 50/50 672 kg/ha; 3) Sodium Azide 112 kg/ha; 4) Multiguard FFA; 5) Vapam 935 L/ha; 6) Chloropicrin 336 kg/ha; 7) Inline 468 L/ha; 8) Iodomethane/Chloropicrin 30/70 448 kg/ha (Midas). The crop in this trial was liatris. With the exception of iodomethane/chloropicrin and the control, the alternatives controlled Pythium. The alternatives, except iodomethane/chloropicrin, chloropicrin, and the control, controlled Fusarium. Weed control was comparable among the alternatives in most cases, with

Multiguard FFA and the control providing the least level of control. Although iodomethane/chloropicrin did not control pathogens, it is suspected that it may be due to an application malfunction. At harvest, there was no significant difference in yield (stems/m²)

The crop in trial 8 was freesia. This trial compared five rates of Inline: 187 L/ha, 280.5 L/ha, 374 L/ha, 467.5 L/ha, and 523.6 L/ha and a control. Control of *Pythium ultimum* and weeds, including mustard, was good across all treatments compared to the control. Also, stems were taller, and there was better plant vigor across all treatments compared to the control. *Fusarium* yellows was not significantly different for any of the treatments (including the control).

Freesia was again used in Trial 9. This trial compared an untreated control, Midas (50:50) 448 kg/ha, Inline 523.6 L/ha, Multiguard 672 kg/ha, and Multiguard + Vapam 672 kg/ha. Weed counts were lower with all treatments except the control. *Pythium ultimum* control was better with all treatments with the treatments compared to the control, with the other treatments providing better control than Multiguard alone.

Trial 10 was conducted with liatris. Treatments were: untreated control, Midas (50:50) 448 kg/ha, chloropicrin 336 kg/ha followed by Vapam 701.25 L/ha, InLine 187 L/ha, Inline 187 L/ha + Vapam 350.625 L/ha, Inline 187 L/ha + Vapam 701.25 L/ha, dimethyl disulfide 448 kg/ha, dimethyl disulfide + chloropicrin (50:50) 448 kg/ha, Vapam 701.25 L/ha, sodium azide 112 kg/ha, Multiguard 672 kg/ha, and Multiguard + Vapam (50:50) 672 kg/ha. Weed pressure was high, and all treatments provided poor control. The lowest counts of *Pythium ultimum* were found with Midas, chloropicrin + Vapam, Multiguard + Vapam, and Vapam. Treatements that did not provide control were Multiguard, sodium azide, dimethyl disulfide + chloropicrin, and dimethyl disulfide. The Multiguard, Vapam, Inline and both dimethyl disulfide treatments did not have better plant vigor than the control. Both Multiguard and the dimethyl disulfide alone treatments did not have improved plant height compared to the control. The other treatments did have better plant vigor and height compared to the control.

Several trials were in progress at the time of the report and not all of the trials are discussed here. These trials will be included in a future report (see below).

Evaluation of Alternatives to Methyl Bromide for Floriculture Crops (Gerik, 2005b):
All of the trials described below were conducted using drip irrigation for the alternatives. Only three of the trials include a methyl bromide control but the results of all of the trials are summarized below.

A trial with calla lilies was conducted as Los Coches Rancho near Soledad, California. The treatments were: Midas 50/50 (iodomethane/chloropicrin) 336 kg/ha; Midas 50/50 (iodomethane/chloropicrin) 168 kg/ha; Inline (1,3-D/chloropicrin) 359 L/ha; Inline (1,3-D/chloropicrin) 191.675 L/ha; Vapam (metam-sodium) 701.25 L/ha; chloropicrin 336 kg/ha followed by Vapam (metam sodium) 701.25 L/ha a week later; and an untreated control. The treatments were made on April 10, 2003. Nutsedge pressure was high. The treatments provided significantly better control of nutsedge compared to the control during sampling in late April, but the number of nutsedge per plot was significantly higher than the control for a number treatments in late June. All treatments provided significantly better control than the untreated control for pigweed, lambsquarters, and total weeds per plot. Compared to the control, populations of *Pythium* spp. were significantly lower with all treatment and populations of *Fusarium oxysporum* were lower with all treatments except 1,3-D/Pic at the 191.675 L/ha rate. There were no significant differences for average stand, percent disease in June 2003, weed counts, number of flowers, total bulbs, salable bulbs and percent rot. It is expected that a factor other than disease or weed pressure, such as a residual herbicide, affected the growth of the crop in this trial.

Two trials were conducted at the Amesti Ranch near Watsonville, California. The crop in both trials was calla (*Z. albomaculata* (Hook) Baill.). The treatments in the first trial were: Midas 50/50 (iodomethane/chloropicrin) 336 kg/ha; Midas 50/50 (iodomethane/chloropicrin)168 kg/ha; Midas 30/70 (iodomethane/chloropicrin) 448 kg/ha; Midas 30/70 (iodomethane/chloropicrin) 224 kg/ha; Inline (1,3-D/chloropicrin) 359 L/ha; Inline (1,3-D/chloropicrin) 191.675 L/ha; chloropicrin 336 kg/ha followed by Vapam (metam sodium) 701.25 L/ha a week later; chloropicrin 224 kg/ha followed by Vapam (metam sodium) 701.25 L/ha a week later; and an untreated control. Treatments were made in May 2003 and there were six replications. Compared to the control, all treatments provided significantly greater volunteer calla control, *Pythium* control, higher vigor ratings, lower disease ratings in July 2004, greater numbers of total and salable bulbs and higher wholesale value. In addition, disease counts in October 2003 and the percent of root rot were generally better with the treatments compared to the control. There were no significant differences between the treatments and control for the number of nusedge, *Fusarium* control, and stand counts.

The second trial at the Amesti Ranch included the following treatments: Multiguard FFA 672 kg/ha; SEP-100 840 kg/ha (sodium azide 168 kg ai/ha); Multiguard Protect + Vapam 50/50) 672 kg/ha; Propylene Oxide 464.8 kg/ha; Agent 2B 448 kg/ha; SEP-100 560 kg/ha (sodium azide 112 kg ai/ha); dimethyl disulfide (DMDS) 672 kg/ha; DMDS + chloropicrin 50/50 672 kg/ha; and an untreated control. Only the sodium azide treatments and the Multiguard + Vapam treatment significantly reduced volunteer callas. Treatments had significantly higher vigor rating than the control except for sodium azide at 168 kg/ha, Multiguard FFA and DMDS alone. Vigor ratings taken at a later date showed that DMDS alone and Multiguard FFA were not significantly better than the control. There were no significant differences between the treatments and the control for stand counts, disease counts, number of nutsedge, *Pythium* spp. populations, *Fusarium oxysporum* populations, percent root rot, total bulbs, salable bulbs, and value.

A trial with Mellano & Company in San Luis Rey with myrtle (*Myrtus communis* L.) was conducted with the following treatments: untreated control; Midas 50/50 (iodomethane/chloropicrin) 448 kg/ha; Midas 33/67 (iodomethane/chloropicrin) 448 kg/ha; Inline (1,3-D/chloropicrin) 523.6 L/ha; and Inline (1,3-D/chloropicrin) 359 L/ha. Significantly fewer dead myrtle plants were observed with the iodomethane/chloropicrin treatments and the 1,3-D/chloropicrin 523.6 L/ha treatment compared to the control. Compared to the control, *F. oxysporum* populations were significantly lower with the 1,3-D/Pic treatments. *Pythium* spp. populations were below the detection limit. No significant differences were found for the percentage of plant with new growth and vigor. This trial is ongoing.

At Por La Mar Nursery in Goleta, three trials were conducted with the following treatments: Methyl bromide/chloropicrin 50/50 448 kg/ha; Midas 50/50 (iodomethane/chloropicrin) 448 kg/ha; InLine (1,3-D/chloropicrin) 359 L/ha; and an untreated control. The crops planted in these trials were snapdragon, Dutch iris, or stock. These trials were conducted on virgin soil. In all trials, the treatments provided significantly greater control *Pythium* spp. than the control. In the Dutch iris trial, Midas significantly reduced *Fusarium* populations compared to the untreated control and methyl bromide/chloropicrin treatment. In the stock trial, weed control was considered fair but the incidence of weeds was low. Also, all treatments provided inadequate control of Sclerotinia stem rot. There were no significant differences between treatments for *Fusarium* in the snapdragon and stock trial. Crop height was not significantly different between the control and treatments in any of the trials.

ORNAMENTALS – RANUNCULUS – TABLE 16.3: EFFECTIVENESS OF ALTERNATIVES – WEEDS

KEY PEST: WEEDS IN RANUNCULUS	WEED CONTROL AND RANUNCULUS VIGOR AFTER PREPLANT DRIP APPLICATION OF PESTICIDES IN SANDY SOIL				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	# OF REPS	DISEASE (% OR RATING)		# OF REPS	PLANT VIGOR*
		CLOVER (#/LINEAR M)	TOTAL WEEDS (#/ LINEAR M		
Metam sodium 364 kg/ha	6	13.5 a	13.7 a	6	9.2 ab
Iodomethane/chloropicrin 392 kg/ha	6	15.3 a	15.3 a	6	8.7 b
Chloropicrin 168 kg/ha	6	9.7 a	10.3 a	6	9.7 ab
Chloropicrin 336 kg/ha	6	12.8 a	13.3 a	6	9.7 ab
Sodium azide 112 kg/ha	6	12.2 a	12.2 a	6	8.7 b
1,3-D/chloropicrin 168 kg/ha	6	11.5 a	11.5 a	6	10.0 a
1,3-D/chloropicrin 336 kg/ha	6	8.3 a	8.3 a	6	9.5 ab
Untreated-tarped	6	15.3 a	16.8 a	6	6.0 c

(Elmore et al., 2003a)
* Visual evaluation: 10 = vigorous, 0 = dead

CALIFORNIA ORNAMENTALS – TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D plus chloropicrin	Nematodes and Diseases (no control of weeds or previous crop)	10 to 25 %	25%
Dazomet	Multiple		25%
Metam Sodium	Multiple		20%
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**20 to 25%**

Yield losses will vary by species but, based on expert opinion for two representative crops, ranunculus and caladiums, an estimate has been determined. The experts are a cut flower producer and a researcher located in different areas of the country. Based on grower experience, it is estimated that 10 to 35 percent yield losses could occur without methyl bromide. These yield losses may be higher in highly diseased fields. Quality is also a major concern for the industry. In addition, ranunculus exported to Japan, Canada, and Europe need a certificate stating that it has been grown in a manner not conducive to certain diseases, which generally means in a field fumigated with methyl bromide. Even in crops without these regulations, consumers expect a high quality product. Selling a product that is not of high quality will cause growers to lose customers. There are some promising alternatives for many crops, but more time is needed to determine what particular alternatives will work with individual crops to meet customer standards and avoid yield losses if methyl bromide can no longer be used (Mellano, 2003). In ranunculus, a 50 percent yield loss (flowers and tubers) can occur due to soil pathogens (Elmore et al., 2003b).

Currently, the applicants do not consider any alternative to be a feasible replacement for methyl bromide in this diverse sector. However, in an attempt to provide an estimate the potential impacts from the adoption of the most common methyl bromide alternatives, the table above presents likely yield losses.

CALIFORNIA ORNAMENTALS - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?:

Research is currently being conducted to identify potential alternatives. Please refer to Section 16 and Section 23.

CALIFORNIA ORNAMENTALS - 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

A number of technologies are currently being used in this sector, including integrated pest management, crop rotation, fallow periods, hand weeding, etc. However, these practices are still not sufficient to control the key target pests without the use of methyl bromide. The growers are also trialing plastic culture for medium term crops that would mimic strawberry production. However, most crops fall into short and long term.

CALIFORNIA ORNAMENTALS - SUMMARY OF TECHNICAL FEASIBILITY

Without methyl bromide, certain growers of various species will suffer both yield and quality losses. In addition growers who rotate several species of ornamentals on a particular field need to kill crop residue from previous crops to eliminate contamination, as well as control other weeds and pathogens. Due to the diversity and complexity of the cut flower and foliage industry, an additional 2 to 3 years are needed to complete ongoing research into implementation of methyl bromide alternatives. Alternatives have not been found for all species. Some of the alternatives that have been found for other crops (such as 1,3-D for Easter lilies in Oregon) may not be feasible for floriculture in general because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, and buffer zone requirements. In addition, township caps limit the use of 1,3-Dichloropropene in California. Other alternatives provide inconsistent control or have restrictions that limit their use at this time. Growers also need time to transition to the alternatives.

In this industry, the fumigation situation and need for methyl bromide varies by species. Although there are some potential alternatives, there is not enough grower experience and research to justify to switching to alternatives by the 2008 growing season.

FLORIDA ORNAMENTALS - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

FLORIDA ORNAMENTALS - 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

FLORIDA ORNAMENTALS - TABLE 10.1: KEY DISEASES AND WEEDS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY DISEASE(S) AND WEED(S) TO GENUS AND, IF KNOWN, TO SPECIES LEVEL	SPECIFIC REASONS WHY METHYL BROMIDE NEEDED
Florida	All soil borne diseases, weeds, and nematodes. Includes *Fusarium* spp., *Rhizoctonia* spp., *Phytoplithora*, Stromatinia, *Pythium* spp., *Erwinia*, and most soil nematodes i.e. *Meliodogyne* spp., and previous crop propagules. Specific pest problems vary by individual crop and variety. See Appendix C for more detailed information.	These diseases are common, abundant, and spread through/by water. Florida has areas of tropical and sub-tropical climate, which is conducive to the spread of these diseases. Alternatives have not been found for all species. Some of the alternatives that have been found for other crops may not be feasible for floriculture because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, and buffer zone requirements (Elmore et al., 2003a). Due to the diversity and complexity of the cut flower and foliage industry, additional time is needed to complete ongoing research into implementation of methyl bromide alternatives and to allow time for registering materials.

FLORIDA ORNAMENTALS - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE
(Place major attention on the key characteristics that affect the uptake of alternatives):

FLORIDA ORNAMENTALS - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	ORNAMENTALS
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Cuttings, bulbs
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Annual and perennial
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	Caladiums are planted between the middle of March and the middle of April each year. Caladiums are dug annually from November until the middle of March. The fields are fumigated between harvest and the next planting. A more complex production system for a grower may involve several species. The typical cut flowers grown are snapdragons, lilies, gladiolus, lisianthus, delphinium, and sunflowers. Growers rotate to other cut flower species but not to other crops. Planting occurs between August and February, with harvesting occurring October through May. Two to three plantings occur each year, with only one application of methyl bromide each year. Most growers produce numerous species, including annuals, perennials, and bulbs, throughout the farm. The rotation involving all of these species would be more complex than the examples above.
SOIL TYPES: *(Sand, loam, clay, etc.)*	All. Caladiums are grown in central Florida, mostly on muck but with new acreage on sand. Applications on muck soil require a higher application rate because it is more difficult for the fumigant to be distributed evenly in this soil type.
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	In general, once every year although it may occur less often on a substantial portion of the acreage in this sector that produce perennials and gladiolus. With one methyl bromide application/year, growers usually get 2 to 3 plantings/year.
OTHER RELEVANT FACTORS:	None identified.

Tables 11.2 and 11.3 are examples of the characteristics of climate and crop schedule for two species – caladium and cut flowers. These characteristics may vary for individual species.

FLORIDA ORNAMENTALS - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – CALADIUM

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	9a – 11 Plant hardiness zone											
RAINFALL *(mm)**	65.5	50.0	72.6	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8
OUTSIDE TEMP. *(℃)**	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
FUMIGATION SCHEDULE	X											
PLANTING SCHEDULE		X										
HARVESTING SCHEDULE									X	X	X	X

* Date based on Tampa, Florida records for 1971–2000.

FLORIDA ORNAMENTALS - TABLE 11.3 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE – CUT FLOWERS

	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC	JAN	FEB
CLIMATIC ZONE	9a – 11 Plant hardiness zone.											
RAINFALL *(mm)**	65.5	50.0	72.6	134.1	175.8	193.3	152.7	65.0	42.7	158.8	62.0	66.8
OUTSIDE TEMP. *(℃)**	19.4	22.1	25.3	27.6	28.2	28.2	27.3	24.1	19.2	17.3	16.0	16.9
FUMIGATION SCHEDULE				X	X	X	X	X	X	X	X	X
PLANTING SCHEDULE						X	X	X	X	X	X	X
HARVESTING SCHEDULE	X	X	X					X	X	X	X	X

- Date based on Tampa, Florida records for 1971–2000.

According to the 2002 Census of Agriculture, cut flowers and florist greens were grown on 3,402 ha (outdoors) and foliage plants were grown on 1,198 ha (outdoors). Approximately 2,511 additional ha of cut flowers, florist greens, and foliage plants were grown indoors (under glass) (2002 Census of Agriculture).

Caladiums are grown on 642 ha. The remaining area is for other species of cut flowers, foliage and bulb crops (See Tables 11.4 and 11.5). Although it would be useful to have more accurate acreage information for each species this has been difficult to obtain for several reasons. 1) There are hundreds of species of cut flowers, foliage, and bulb crops grown, and often several species are grown in the same field in the same year. 2) The species grown are constantly changing and fluctuations may occur at any time. For example, several years ago sunflowers were not a major commercial crop in Florida but currently it is a major crop. 3) There are no records available that show which crops are grown at any one time. Due to the sheer number of species, and the constant fluctuation in the industry, the acreage of each species is unable to be determined. Table 11.4 shows a few of the major crops grown and the number of spikes or stems produced, although acreage information was not available. This information indicates that gladioli are another major crop grown in Florida, and would be expected to be grown on more acreage than some of the other crops.

The only three cut flower species identified by the Florida Agricultural Statistics Service are gladioli, lilies and snapdragon. These are assumed to have the highest acreage (See Table 11.1b below for production information). These crops have also been identified by the applicant as using MB.

FLORIDA ORNAMENTALS - TABLE 11.4 CROP PRODUCTION FOR CERTAIN CUT FLOWER SPECIES[2]

	2001		2002		2003	
Crop	# of producers	Quantity sold (1000 spikes)[1]	# of producers	Quantity sold (1000 spikes)[1]	# of producers	Quantity sold (1000 spikes)
Gladioli	4	40,331	4	49,581	4	39,444
Snapdragons	5	6,806	4	4,415	4	4,757
Lilies	4	3,031	3	2,257	-	-
Other cut flowers	-	-	9	-	10	-

[1] Quantity of lilies sold 1000 stems.
[2] This table only includes data for growers with sales over $100,000.
Source: Foliage, Floriculture, and Cut Greens, 2003; Foliage, Floriculture, and Cut Greens, 2004

Using several data sources, a rough estimate of the number of acres of gladioli grown can be obtained. The quantity sold, shown in Table 11.4, was averaged and divided by an average yield, which was calculated using data from 1991 to 1998. This method resulted in approximately 638 ha of gladioli. This number does not take into account the variability in yield in an individual year or if yields have changed since 1998 (USDA, 1999).

FLORIDA ORNAMENTALS - TABLE 11.5 OTHER CUT FLOWER SPECIES GROWN IN FLORIDA

Crop	Crop Rotation Limitation
Delphinium	These species are often sensitive to the same insects and pests as the other cut flower, foliage and bulb species.
Larkspur	
Gerbera	
Lisianthus	
Sunflower	
Aster	
Chrysanthemum	

FLORIDA ORNAMENTALS – 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Caladium

Caladiums are dug annually from November through March 15. The time frame between lifting the previous year's crop and planting the new crop is about 30 days, or possibly shorter when severe cold temperatures or unexpected rainfall occurs. Any product with a fallow (post-treatment) time of 30 days or more will not work for this industry as fields must be planted before April 15 each year and cannot be prepared for planting until the middle of March.

Cut Flowers

Cut flowers are often marketed for a certain time of year or holiday. Missing specific dates can be detrimental to the grower.

FLORIDA ORNAMENTALS - 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

FLORIDA ORNAMENTALS - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE**

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	1,416	1,416	1,416	1,416	1,416	1,416
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation	Nearly all Flat Fumigation
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(total kg)*	622,328	622,328	622,328	622,328	622,328	622,328
FORMULATIONS OF METHYL BROMIDE *(methyl bromide /chloropicrin)*	98:2	98:2	98:2	98:2	98:2	98:2
METHOD BY WHICH METHYL BROMIDE APPLIED *(e.g. injected at 25cm depth, hot gas)*	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked	Chiseled or shanked
APPLICATION RATE OF ACTIVE INGREDIENT IN kg/ha*	439	439	439	439	439	439
ACTUAL DOSAGE RATE OF ACTIVE INGREDIENT *(g/m^2)*	43.9	43.9	43.9	43.9	43.9	43.9

***Based on industry assumptions.*

In Florida (FL), the higher rates tend to be used on muck soils and the lower rates on sandy soils. Growers are expected to use a 67:33 formulation in the future, although this may vary depending on the crop grown and the pest situation. It is not clear that a 50:50 formulation is feasible.

FLORIDA ORNAMENTALS - PART C: TECHNICAL VALIDATION

FLORIDA ORNAMENTALS - 13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

FLORIDA ORNAMENTALS – TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-Dichloropropene	1,3-D is not very efficacious on its own for weed and disease control. Buffer zones make using this alternative difficult because often flowers are produced on small parcels of land, often near homes. 1,3-D cannot be used in greenhouses. For caladiums, chloropicrin was needed in addition to 1,3-D to reach the same yield as methyl bromide plus chloropicrin (Overman and Harbaugh, 1983). The plant-back window for caladiums is variable and the 1,3-D plant-back interval will limit use on some acres. In addition, caladium growers are reluctant to use 1,3-D because it does not control weeds. Growers also have to tarp 1,3-D and do not have the equipment to do it themselves (they can apply metam sodium themselves) (Gilreath, 2004).	No.

Name of Alternative	**Technical and regulatory* reasons for the alternative not being feasible or available**	**Is the alternative considered cost effective?**
Metam sodium	Performance with metam sodium is erratic and inconsistent, depending on soil type, moisture content, and temperature. Many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Also, pest populations tend to build up over time with metam sodium. Repeat use results in an increase in the population of bio-degraders of the active ingredient. Problematic for bulb growers is the fact that it suppresses active nematodes, and not the eggs. Buffer zones make using this alternative difficult because flowers are produced on small parcels of land. In addition, the plant back restrictions may cause some growers to be able to grow fewer crops in a year. Metam sodium is used by some growers of caladiums in rotation with methyl bromide, due to the expense of methyl bromide. Growers feel that they can use metam sodium if they used methyl bromide the previous year. The growers that have tried using metam sodium 2 years in a row had bad nematode infestations the second year and will now only use it once every 2 years. Most growers will not use metam sodium because they must meet certification requirements (free of nematodes) for certain markets (several U.S. states and some international markets) (Gilreath, 2004). Studies conducted on snapdragon by McSorley and Wang (2003 and 2004) showed that this combination provided comparable control to methyl bromide. However, the first study contained soils with light pest pressure because it had previously been treated with methyl bromide + chloropicrin. In addition, this site had sandy soils, and different results could be obtained with other soil types. In the second year, the sites were contaminated with weeds seeds and *Fusarium* spp., so the results are more difficult to interpret. Snapdragons reproduce by seed, so it is not clear if metam sodium is effective for bulb crops, especially over the long term. Additional research is needed. This fumigant is currently used and will continue to be used where it gives adequate pest control. In some cases it is used to suppress pest populations between methyl bromide treatments. While this reduces the number of times methyl bromide must be applied, it does not eliminate the need for methyl bromide. It is unlikely that metam sodium will replace significant portions of the current use of methyl bromide.	No

NAME OF ALTERNATIVE	**TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE**	**IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?**
Dazomet	In some cut flowers (carnation and chrysanthemum) dazomet was effective against *Fusarium*, *Rhizoctonia*, *Erwinia*, and *Pseudomonas.* Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year.	No.
Chloropicrin	There is reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. Weed control is also poorer than with methyl bromide (Ragsdale, 2004). Adequate efficacy for the pest complex cannot be achieved with lower use rates.	No.
MITC	Same issues described above for metam sodium and dazomet.	No.
NON CHEMICAL ALTERNATIVES		
Biofumigation	Biofumigation is still largely in the experimental stages. (Pizano, 2001). Specific brassicas as well as specific years yield variable amounts of activity. While this alternative may provide some control, the control of all target pests is not sufficient. Also, brassica waste must be available in huge quantities to provide at best minor effects. The extremely large volume of raw material required makes this impractical.	No.
Solarization	Solarization takes several weeks to control many pests to a depth of 30 cm. This length of time for a treatment is not economically feasible in the intensive, year-round production situation of the cut flower industry (Pizano, 2001). In a study conducted on snapdragon, McSorley and Wang (2004) showed that this option had similar yields to the other treatments but the plants were shorter. The site was treated with methyl bromide/chloropicrin the previous crop season, so it is not clear if this could have impacted results. The site also had sandy soils, and different results could be obtained with other soil types. In addition, the sites were contaminated with weeds seeds and *Fusarium* spp. after fumigation and before planting, so the results are difficult to interpret. Snapdragons reproduce by seed, so it is not clear if this combination is effective for bulb crops, especially over the long term. Additional research is needed. The study mentioned in the above paragraph also referred to another study in which solarization in Florida has been successful with impatiens and vinca.	No.

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	
Steam	Steam can be a technically effective alternative in some cases. Reasons cited for not using steam for this crop system are high initial cost and an adverse affect on soil organic matter in enclosed structures. Some greenhouse growers have adapted this approach already in crops where it works better (such as Freesia). In-field steaming is not a feasible alternative due to lack of machinery that can deliver the steam, differences in soil type, and environmental impact of fuel use.	No.
Biological control	Results with biological control agents may vary with field or environmental conditions (Pizano, 2001). Even in small containers, biological control is not reliable for soil-borne pathogens.	No.
Crop residue compost/Crop rotation/fallow	Rotation with other cut flower species is used extensively in cut flower production. However, in annual cropping they are generally too short for the full effects of rotating schemes to be effective. The previous crop (bulbs, corms) often contaminate the following crop or may harbor pathogens. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001). Most cut flower species are sensitive to the same pathogens. Flower rotations are generally not a true rotation in the pest control sense.	No.
Flooding and water management	Beds are generally designed and graded for good drainage to prevent standing water. Flooding could increase the incidence of certain diseases and is also time restrictive.	No.
General IPM	Although IPM is currently practiced, this alone will not control weed and disease pests.	No.
Grafting/resistant rootstock/plant breeding	Grafting/resistant rootstock/plant breeding are not feasible alternatives. Given the thousands of varieties of ornamentals, plant breeding for the variety of pests is not practical.	No.
Organic amendments/compost	Not effective alone in weed or pest management; may be incorporated as part of an IPM program. Does not provide adequate weed and disease control.	No.
Physical removal/sanitation	Appropriate sanitation practices are already used extensively.	No.
Resistant cultivars	Given the thousands of varieties of ornamentals, developing resistant cultivars for each variety, each with unique pest problems, is not practical. Choices are often market driven.	No.
Soilless culture / Substrates /plug plants	Container production may be possible in higher value cut flower crops but it not generally feasible, especially for deeper rooted crops and on large acreage.	No.
COMBINATIONS OF ALTERNATIVES		

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
1,3-Dichloropropene + chloropicrin	For caladiums, chloropicrin was needed in addition to 1,3-D to reach the same yield as methyl bromide plus chloropicrin (Overman and Harbaugh, 1983). 1,3-D is also limited by the plant-back interval, the lack of weed control, and the lack of equipment necessary to fumigate with 1,3-D (Gilreath, 2004). Limitations to chloropicrin include poorer weed control than methyl bromide, and a reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. In Florida, 1,3-D + chloropicrin, followed by metam sodium a week later, has shown control of diseases and nematodes, but does not adequately control weeds.	No.
1,3-Dichloropropene + chloropicrin + pebulate	Pebulate is currently not registered. For caladiums, chloropicrin was needed in addition to 1,3-D to reach the same yield as methyl bromide plus chloropicrin (Overman and Harbaugh, 1983). 1,3-D is also limited by the plant-back interval, the lack of weed control, and the lack of equipment necessary to fumigate with 1,3-D (Gilreath, 2004). Limitations to chloropicrin include poorer weed control than methyl bromide, and a reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.
Dazomet (Basamid) + chloropicrin	In some cut flowers (carnation and chrysanthemum) dazomet was effective against *Fusarium*, *Rhizoctonia*, *Erwinia*, and *Pseudomonas.* Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year. Limitations to chloropicrin include poorer weed control than methyl bromide, and a reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences.	No.

Name of Alternative	**Technical and regulatory* reasons for the alternative not being feasible or available**	**Is the alternative considered cost effective?**
Metam sodium + chloropicrin	Good disease control can be provided by chloropicrin. Metam sodium is used by some growers of caladiums in rotation with methyl bromide. The growers that have tried using metam sodium 2 years in a row had bad nematode infestations the second year and will now only use it once every 2 years. Most growers will not use metam sodium because they must meet certification requirements (free of nematodes) for certain markets (several U.S. states and some international markets) (Gilreath, 2004). This fumigant is currently used and will continue to be used where it gives adequate pest control. It will be unlikely to replace significant portions of current use of methyl bromide. Limitations to chloropicrin include poorer weed control than methyl bromide and a reluctance to use chloropicrin in many areas due to the proximity of cut flower fields to residences. In general, weed and nematode control is not adequate with this combination. In addition, these chemicals would have to be applied separately, requiring two applications. Studies conducted on snapdragon by McSorley and Wang (2003 and 2004) showed that this combination provided comparable control to methyl bromide. However, the first study contained soils with light pest pressure because it had previously been treated with methyl bromide + chloropicrin. In addition, this site had sandy soils, and different results could be obtained with other soil types. In the second year, the sites were contaminated with weeds seeds and *Fusarium* spp., so the results are more difficult to interpret. Snapdragons reproduce by seed, so it is not clear if this combination is effective for bulb crops, especially over the long term. Additional research is needed on this alternative.	No.

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Metam sodium + crop rotation	Metam sodium is used by some growers of caladiums in rotation with methyl bromide. The growers that have tried using metam sodium 2 years in a row had bad nematode infestations the second year and will now only use it once every 2 years. Most growers will not use metam sodium because they must meet certification requirements (free of nematodes) for certain markets (several U.S. states and some international markets) (Gilreath, 2004). This fumigant is currently used and will continue to be used where it gives adequate pest control. It will be unlikely to replace significant portions of current use of methyl bromide. Rotation would be to other flower crops. In annual cropping they are generally too short for the full effects of rotating schemes to be effective. The previous crop (bulbs, corms) often contaminate the following crop or may harbor pathogens. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001). Also, other cut flower species are often sensitive to the same pests and diseases, making rotation an infeasible option for pest management. Instead of applying methyl bromide several times per year, some growers are rotating to less sensitive crops and treating with metam sodium to keep pest pressures low. However, eventually methyl bromide needs to be applied again or pest pressures will become too high. In California, some gladiolus growers are leasing land to strawberry growers. The strawberry growers fumigate the land with methyl bromide, and a crop of gladiolus can follow without additional methyl bromide fumigation. This arrangement is not feasible for calla lily growers because calla lilies are very susceptible to the root disease complex supported by strawberries and raspberries. Complicating crop rotation is the high number of crop species and varieties, with uncertainties as to their susceptibilities to nematodes and diseases.	No.

** Regulatory reasons include local restrictions (e.g. occupational health and safety, local environmental regulations) and lack of registration.*

FLORIDA ORNAMENTALS - 14. LIST AND DISCUSS WHY REGISTERED *(and Potential)* PESTICIDES AND HERBICIDES ARE CONSIDERED NOT EFFECTIVE AS TECHNICAL ALTERNATIVES TO METHYL BROMIDE:

FLORIDA ORNAMENTALS – TABLE 14.1: TECHNICALLY INFEASIBLE ALTERNATIVES DISCUSSION

NAME OF ALTERNATIVE	DISCUSSION
Herbicides and fumigation with methyl bromide, 1,3-D and chloropicrin, metam sodium and chloropicrin	Caladium - All were effective for weeds but positive results may have been influenced by previous years of MeBr fumigation (Gilreath, et al, 1999). However, there was control of *Fusarium* and only MeBr reduced *Pythium*. Herbicides are more feasible for perennials if they are registered. The short time interval between crops (a crop may only take 90 days) often restricts the use of herbicides due to replant intervals or phytotoxicity. Also, herbicides are often selective and there are a limited number registered.
Hot water dips	Caladium tubers are cleaned with hot water dips (49-50°C for 30 minutes). A fungicide/bactericide dip may follow. Some growers may spray the rhizomes with a fungicide to protect them from diseases. The hot water dip is effective at reducing root knot nematode on the rhizomes but fumigation is needed to maintain the control. Controlling *Fusarium* on the rhizomes will not control losses if the soil is contaminated by the previous year's pests.
Sodium azide	Preliminary results in a calla trial suggest that sodium azide may not be a feasible alternative in this crop due to reduced crop vigor and increased mortality (Gerik, 2003).

FLORIDA ORNAMENTALS - 15. LIST PRESENT *(and Possible Future)* REGISTRATION STATUS OF ANY CURRENT AND POTENTIAL ALTERNATIVES:

FLORIDA ORNAMENTALS – TABLE 15.1: PRESENT REGISTRATION STATUS OF ALTERNATIVES

NAME OF ALTERNATIVE	PRESENT REGISTRATION STATUS	REGISTRATION BEING CONSIDERED BY NATIONAL AUTHORITIES? (Y/N)	DATE OF POSSIBLE FUTURE REGISTRATION:
Iodomethane	Not registered	Yes	Unknown
Sodium azide	Not registered	Registration package not submitted	Unknown
Propargyl bromide	Not registered	Registration package not submitted	Unknown
Furfural	Not registered	Yes	Unknown
Muscador albus strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

FLORIDA ORNAMENTALS - 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED

For additional studies on ornamentals, see data included for California. These studies were separated by location of the study, but some of the crop species, pests, and other issues are the same.

Evaluation of DMDS for Production of Ornamental Cockscomb (*Celosia argentea*) (Church and

Rosskopf):

A study with the crop ornamental cockscomb (*Celosia argentea*) was conducted with the following treatments: methyl bromide: chloropicrin 98:2 at 448 kg/ha; dimethyl disulfide (DMDS) 784.63 kg/ha; DMDS: chloropicrin 224.18 kg/ha, and an untreated control. In one trial, the study was not completed due to flooding but weed counts were taken at 4 and 8 weeks after treatment before the end of the study. This site had high weed pressure and the treatments all provided significantly better control compared to the untreated control. The DMDS treatments and the methyl bromide treatment were not statistically different.

A second trial was done with the same treatments described above, except DMDS: chloropicrin, at a separate location. This site had low weed pressure and there were no significant differences between treatments for weed control. Both DMDS and methyl bromide provided statistically significant better control of *Pythium* root rot and nematodes (*Meloidogyne* spp.). Plant height with the methyl bromide treatment was significantly higher than the untreated control and the DMDS treatment. The number of stems harvested was not significantly different for all treatments; however, the number of marketable stems was significantly greater with the DMDS and methyl bromide treatments compared to the control.

Soil Fumigant and Herbicide Combinations for Caladium (Gilreath, McSorley, and McGovern):

Near Lake Placid, Florida during the 1998 production season, a study was conducted with caladium using the following treatments: untreated control (no herbicide and no fumigant applied); methyl bromide/chloropicrin 90/10 at 504 kg/ha; 1,3-D/chloropicrin 83/17 at 327.25 L/ha; metam sodium at 701.25 L/ha + chloropicrin at 224 kg/ha. All treatments, except the untreated control, received an application of oryzalin, and the 1,3-D and metam sodium treatments also received an application of metolachlor. The area was previously fumigated with methyl bromide.

The study looked at weed control, nematodes, *Fusarium*, *Pythium*, *Rhizoctonia*, and tuber production. The actual data was not provided but the results were summarized. The study found that a potential alternative may be 1,3-D + chloropicrin + metolachlor applied at planting + oryzalin applied midsummer. In addition, the application of metolachlor at planting, after methyl bromide fumigation, would have improved weed control.

Screening of Reduced Risk Compounds for Fungicidal and Herbicidal Activity (Rosskopf and Basinger):

This study screened several compounds, including AJMC-330 and AJMC-334, using laboratory and greenhouse bioassays. Benomyl was used as the control in the fungicide trial, which evaluated the compounds for activity on *Fusarium oxysporum*. Herbicidal activity of these compounds was evaluated using the following weeds: purple nutsedge, smooth pigweed, and barnyardgrass. AJMC-330 and AJMC-334 both performed well in the screens.

Report for IR-S Advanced Stage Biopesticide Program 2002-03

Three trials were conducted to evaluate various biopesticides on plant diseases for the crops liripoe, ivy and periwinkle. The trials did not include a methyl bromide control. In the liriope and ivy trials, BioPhos was tested for efficacy again *Phytophthora palmivora* and for phytotoxic effects on the crops. There was limited success with the liriope trial so this trial is not discussed here. In the ivy trial, foliar and drench applications of BioPhos were applied at three concentrations: 0 percent, 2 percent, and 3 percent. BioPhos caused phytotoxic effects to the crop, particularly with the foliar application. However, BioPhos did result in lower disease ratings compared to the control.

In the periwinkle trial, several treatments were evaluated for their effect on *Phytophthora nicotianae*. These treatments include: an untreated control; Actigard (plant defense activator); DieHard (mixture of endo- and ectomycorrhizal fungi), 6% solution, root dip; DiTera (biological nematicide); BioPhos (AgBio 222, FNX-100); FNX-2500; MBI600 (*Bacillus subtillus*); Mycostop (*Streptomyces griseoviridis*); Primastop; and Soligard (*Trichoderma virens*). Periwinkle plants were inoculated with the disease. Most treatments provided significantly better control compared to the untreated control. FNX-100 and FNX-100 provided significantly better control than all other treatments.

ORNAMENTALS – SNAPDRAGON – TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – WEEDS

This study was conducted with soils consisting of 96 percent sand. Also, this study was conducted in an area with low pest pressure because it had been treated with methyl bromide for several years. The researchers stated the need to conduct additional tests to determine long term control with the alternative fumigants, because methyl bromide may have reduced pest populations for all sites.

KEY PESTS: WEEDS IN SNAPDRAGON	**WEED RATING AND YIELDS**				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	**# OF REPS**	**WEED RATING**		**# OF REPS**	**HARVESTED PLANTS PER M OF ROW**
		TOTAL WEEDS/ 7.6 M OF ROW (9 OCT.)	**TOTAL WEEDS/ 7.6 M OF ROW (14 NOV.)**		
Methyl bromide/chloropicrin (98:2) broadcast injection, 504 kg/ha	4	1.25 b	4.75 b	4	117.8 a
Metam sodium, drenched + rototilled, 701 L/ha	4	1.50 b	3.75 b	4	118.0 a
Metam sodium, drenched + rototilled, 701 L/ha +chloropicrin, injected, 168 kg/ha	4	0.50 b	2.00 b	4	116.8 a
Untreated	4	16.25 a	37.00 a	4	109.6 b

(McSorley and Wang, 2003)

ORNAMENTALS – SNAPDRAGON – TABLE 16.2: EFFECTIVENESS OF ALTERNATIVES – WEEDS

This study was conducted at the same site discussed above (See Table 16.1). Except for solarization, the fields received the same treatment as the year before. The solarization plots were treated with methyl bromide + chloropicrin the previous season. In this study, a rain event washed weed seeds and *Fusarium* spp. from untreated border areas into the site, after fumigation had taken place. Plots showed effects from this event during November and plots in two of the replications were destroyed due to the high number of dead plants (these were the areas most affected by the rain). All plots had substantial losses from this event and also caused yields for methyl bromide + chloropicrin yields to be intermediate. The solarized plants also had shorter plants compared to the best fumigation treatment.

KEY PEST: WEEDS IN SNAPDRAGON	WEED RATING AND YIELDS				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES *(include dosage rates and application method)*	# OF REPS	WEED RATING		# OF REPS	HARVESTED PLANTS PER M OF ROW
		TOTAL WEEDS/M^2(2 OCT. 2003)	TOTAL WEEDS/M^2 (20 NOV. 2003)		
Methyl bromide/chloropicrin (98:2) broadcast injection, 504 kg/ha	4	0.0 b	9.0 a	2	62.0 bc
Metam sodium, drenched + rototilled, 701 L/ha	4	0.0 b	10.2 a	2	84.6 ab
Metam sodium, drenched + rototilled, 701 L/ha +chloropicrin, injected, 168 kg/ha	4	0.0 b	15.0 a	2	92.3 a
Solarization	4	0.0 b	19.2 a	2	77.4 ab
Untreated	4	79.8 a	23.5 a	2	39.2 c

(McSorley and Wang, 2004)

FLORIDA ORNAMENTALS – TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS	BEST ESTIMATE OF YIELD LOSS
1,3-D plus chloropicrin	Nematodes and Diseases (no control of weeds or previous crop)	10 to 25 %	25%
Dazomet	Multiple		25%
Metam Sodium	Multiple		20%
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			**20 to 25%**

Yield losses will vary by species but, based on expert opinion for two representative crops, ranunculus and caladiums, an estimate has been determined. The experts are a cut flower producer and a researcher located in different areas of the country. Based on grower experience, it is estimated that 10 to 35 percent yield losses could occur without methyl bromide. These yield losses may be higher in highly diseased fields. Quality is also a major concern for the industry. Consumers expect a high quality product. Selling a product that is not of high quality will cause growers to lose customers. There are some promising alternatives for many crops, but more time is needed to determine which particular alternatives will work with individual crops to meet customer standards and avoid yield losses if methyl bromide can no longer be used (Mellano, 2003). In ranunculus, a 50 percent yield loss (flowers and tubers) can occur due to soil pathogens (Elmore et al., 2003b). The situation is similar for caladiums. Studies conducted on caladiums did not necessarily show yield or quality losses but any losses would depend on pest populations. Herbicides were also used to control weeds that wouldn't be controlled by the fumigant alone. In the first year, growers may experience a 5% reduction in the number of tubers in the most desirable size grades, with a 30% reduction in production in the second year possible. Losses are not likely to exceed 35 to 40%. Growers will likely find successful alternatives but more time is needed to transition to these alternatives (Gilreath, 2004).

Currently, the applicants do not consider any alternative to be a feasible replacement for methyl bromide in this diverse sector. However, in an attempt to provide an estimate of the potential impacts from the adoption of the most common methyl bromide alternatives, the table above presents likely yield losses.

FLORIDA ORNAMENTALS - 17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?:

Research is currently being conducted to identify potential alternatives. Please refer to Section 16 and Section 23.

FLORIDA ORNAMENTALS - 18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

A number of technologies are currently being used in this sector, including integrated pest management, crop rotation, fallow periods, hand weeding, etc. However, these practices are still not sufficient to control the key target pests without the use of methyl bromide.

FLORIDA ORNAMENTALS - SUMMARY OF TECHNICAL FEASIBILITY

Without methyl bromide, certain growers will suffer both yield and quality losses. In addition growers who rotate several species of ornamentals on a particular field, need to kill crop residue from previous crops to eliminate contamination, as well as control other weeds and pathogens. Due to the diversity and complexity of the cut flower and foliage industry, an additional 2 to 3 years are needed to complete ongoing research into implementation of methyl bromide alternatives. Alternatives have not been found for all species. Some of the alternatives that have been found for other crops (such as 1,3-D for Easter lilies in Oregon) may not be feasible for floriculture in general because of high cost, difficulties with quickly treating and replanting fields for multi-cropping, and buffer zone requirements. Other alternatives provide inconsistent control or have restrictions that limit their use at this time. Growers also need time to transition to the alternatives.

In this industry, the fumigation situation and need for methyl bromide varies by species. Although there are some potential alternatives, there is not enough grower experience and research to justify to switching to alternatives by the 2008 growing season.

MICHIGAN HERBACEOUS PERENNIALS - PART B: CROP CHARACTERISTICS AND METHYL BROMIDE USE

MICHIGAN HERBACEOUS PERENNIALS - 10. KEY DISEASES AND WEEDS FOR WHICH METHYL BROMIDE IS REQUESTED AND SPECIFIC REASONS FOR THIS REQUEST

MICHIGAN HERBACEOUS PERENNIALS - TABLE 10.1: KEY DISEASES AND WEEDS AND REASON FOR METHYL BROMIDE REQUEST

REGION WHERE METHYL BROMIDE USE IS REQUESTED	KEY PESTS	SPECIFIC REASONS WHY METHYL BROMIDE IS NEEDED
Michigan Herbaceous Perennials	**Nematodes:** *Meloidogyne hapla*, *Pratylenchus* spp., *Ditylenchus* spp.; **Fungi:** *Pythium* (damping-off, root rot), *Fusarium* (damping-off, root rot), *Phytophthora, Rhizoctonia;* **Weeds**: *Cyperus esculentus* (yellow nutsedge), *Inula brittanica*, *Oxalis stricta*, *Cirsium arvense*, *Rorippa sylvestris*	Research for effective alternatives to MeBr is ongoing with USDA supported research due to be analyzed and reported after 2006 studies end. Until field-tested alternatives can be identified and protocols developed for them, MeBr will be critical to pest management for this industry.

MICHIGAN HERBACEOUS PERENNIALS - 11. (*i*) CHARACTERISTICS OF CROPPING SYSTEM AND CLIMATE

MICHIGAN HERBACEOUS PERENNIALS - TABLE 11.1: CHARACTERISTICS OF CROPPING SYSTEM

CHARACTERISTICS	MICHIGAN HERBACEOUS PERENNIALS
CROP TYPE: *(e.g. transplants, bulbs, trees or cuttings)*	Ornamental herbaceous perennials (e.g., Delphinium, Hosta, Phlox)
ANNUAL OR PERENNIAL CROP: *(# of years between replanting)*	Perennial: 2-year seeded (6% of treated area) and 2-year transplants (29% of treated area) are on a 2 year replant/fumigation cycle; 3-year transplants (65% of treated area) are on a 3 year replant/fumigation cycle
TYPICAL CROP ROTATION *(if any)* **AND USE OF METHYL BROMIDE FOR OTHER CROPS IN THE ROTATION:** *(if any)*	None
SOIL TYPES: *(Sand, loam, clay, etc.)*	Various, light to heavy
FREQUENCY OF METHYL BROMIDE FUMIGATION: *(e.g. every two years)*	Once in 2 to 3 years
OTHER RELEVANT FACTORS:	No other relevant factors identified.

MICHIGAN HERBACEOUS PERENNIALS - TABLE 11.2 CHARACTERISTICS OF CLIMATE AND CROP SCHEDULE

Year 1 of two-year cycle.

Year 1	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**
CLIMATIC ZONE	USDA zones 4a - 6a											
RAINFALL *(mm)*	Not available											
OUTSIDE TEMP. *(℃)*	Not available											
FUMIGATION SCHEDULE[a]			2-year transplants			2-year seedlings; 3-year transplants						
PLANTING SCHEDULE			2-year transplants				3-year transplants	3-year transplants				

Year 2 of two-year cycle.

Year 1	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEPT**	**OCT**	**NOV**	**DEC**	**JAN**	**FEB**
CLIMATIC ZONE	USDA zones 4a - 6a											
RAINFALL *(mm)*	Not available											
OUTSIDE TEMP. *(℃)*	Not available											
FUMIGATION SCHEDULE[a]												
PLANTING SCHEDULE			2-year seedlings									

MICHIGAN HERBACEOUS PERENNIALS - 11. (*ii*) INDICATE IF ANY OF THE ABOVE CHARACTERISTICS IN 11. (*i*) PREVENT THE UPTAKE OF ANY RELEVANT ALTERNATIVES?

Long term research results are to be compiled and analyzed in 2006-2007, to assess the efficacy of alternatives. In addition, the consortium is developing timelines to determine a strategy to transition from MB. Fumigation schedule with MeBr is based on the effectiveness in managing the numerous pests. With alternatives, fumigation will likely have to be increased and timing of seedling and transplant production will be affected. Consequently, the ongoing research program must be completed to address implementation of production processes with newly identified alternatives.

MICHIGAN HERBACEOUS PERENNIALS - 12. HISTORIC PATTERN OF USE OF METHYL BROMIDE, AND/OR MIXTURES CONTAINING METHYL BROMIDE, FOR WHICH AN EXEMPTION IS REQUESTED

MICHIGAN HERBACEOUS PERENNIALS - TABLE 12.1 HISTORIC PATTERN OF USE OF METHYL BROMIDE

FOR AS MANY YEARS AS POSSIBLE AS SHOWN SPECIFY:	1999	2000	2001	2002	2003	2004
AREA TREATED *(hectares)*	248	228	129	130	110	110
RATIO OF FLAT FUMIGATION METHYL BROMIDE USE TO STRIP/BED USE IF STRIP TREATMENT IS USED	flat fumigation	flat fumigation	flat fumigation	flat fumigation	flat fumigation	flat fumigation
AMOUNT OF METHYL BROMIDE ACTIVE INGREDIENT USED *(kg)*	97,477	89,539	50,485	50,961	41,153	41,153
FORMULATIONS OF METHYL BROMIDE *(MB:PIC)*	98:2	98:2	98:2	98:2	98:2	98:2
METHOD BY WHICH METHYL BROMIDE APPLIED	injected	injected	injected	injected	injected	injected
APPLICATION RATE [ACTIVE INGREDIENT] (kg/ha)	392	392	392	392	375	375
ACTUAL DOSAGE RATE [ACTIVE INGREDIENT] *(g/m^2)*	39.2	39.2	39.2	39.2	37.5	37.5

In 2002, 1,316.6 kg of methyl bromide applied to herbaceous perennials in the program states (California, Florida, Michigan, Oregon, Pennsylvania, and Texas). In Michigan, the percent of herbaceous perennials treated with methyl bromide was 1 percent (USDA Agricultural Chemical Usage, 2004).

PART C: TECHNICAL VALIDATION

13. REASON FOR ALTERNATIVES NOT BEING FEASIBLE

MICHIGAN HERBACEOUS PERENNIALS – TABLE 13.1: REASON FOR ALTERNATIVES NOT BEING FEASIBLE

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
CHEMICAL ALTERNATIVES		
1,3-Dichloropropene	1,3-D is not very efficacious on its own for weed and disease control. Some growers have found adequate control when 1,3-D is combined with other fumigants or herbicides.	No.
Metam sodium	Performance with metam sodium is erratic and inconsistent, depending on soil type, moisture content, and temperature. Many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Also, pest populations tend to build up over time with metam sodium. Repeat use results in an increase in the population of bio-degraders of the active ingredient. Buffer zones make using this alternative difficult because ornamentals are produced on small parcels of land. This fumigant cannot be used in urbanized areas.	No
Dazomet	Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year.	No.
Chloropicrin	Weed control is poorer than with methyl bromide (Ragsdale, 2004). Nematodes and weeds are not controlled adequately. Adequate efficacy for the pest complex cannot be achieved with lower use rates.	No.
MITC	Same issues described above for metam sodium and dazomet.	No.

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
NON CHEMICAL ALTERNATIVES		
Biofumigation	This is a process where mustard species (*Brassica* spp.) are grown and ultimately disked into soils. A bioactive breakdown product of some of these species is MITC. Biofumigation is still largely in the experimental stages. (Pizano, 2001). Specific brassicas as well as specific years yield variable amounts of activity. While this alternative may provide some control, the control of all target pests is not sufficient. Also, brassica waste must be available in huge quantities to provide at best minor effects.	No.
Solarization	Solarization is not feasible under Michigan field conditions. Not able to generate acceptable heat to allow spring planting; most effective time for solarization is not compatible with timing for production; uses solar radiation to heat soil under clear plastic, and under certain conditions in some locations in the summer, soil can be heated to as high as 60 C to a depth of 7.5 cm. Effective solarization would likely require several months of covered bed treatments, to heat soil to a sufficient depth (25-30 cm) in order to affect soil-borne pathogens. Seeds of some weed species are resistant even to higher temperatures obtained with solarization. Nutsedges, *Fusarium* spp., *Macrophomina* spp. are not controlled, or unpredictably controlled, by solarization (Elmore et al., 1997). Therefore, this alternative is not considered technically feasible.	No.
Steam	Steam can be a technically effective alternative in some cases. Reasons cited for not using steam for this crop system are high initial cost and high application costs limit widespread use, it is slow, best suited to small acreages, and continuous cropping. Some greenhouse growers have adapted this approach already in crops where it works better (such as Freesia). In-field steaming is not a feasible alternative due to lack of machinery that can deliver the steam, differences in soil type, and environmental impact of fuel use.	No.
Biological control	No biological controls are developed to cover all of the pests. Results with biological control agents may vary with field or environmental conditions (Pizano, 2001). Even in small containers, biological control is not reliable for soil-borne pathogens.	No.
Crop residue compost/Crop rotation/fallow	Crop rotation/fallow does not adequately control the target pests. Rotation would be to other ornamental crops. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001). Rotations are generally not a true rotation in the pest control sense.	No.
Flooding and water management	Beds are generally designed and graded for good drainage to prevent standing water. Flooding could increase the incidence of certain diseases and is also time restrictive.	No.

NAME OF ALTERNATIVE	TECHNICAL AND REGULATORY* REASONS FOR THE ALTERNATIVE NOT BEING FEASIBLE OR AVAILABLE	IS THE ALTERNATIVE CONSIDERED COST EFFECTIVE?
General IPM	Although IPM is currently practiced, this alone will not control weed and disease pests.	No.
Grafting/resistant rootstock/plant breeding	Grafting/resistant rootstock/plant breeding are not feasible alternatives. None of the herbaceous perennials grown are grafted and very few are resistant. Given the thousands of varieties of ornamentals, plant breeding for the variety of pests is not practical.	No.
Organic amendments/compost	Not effective alone in weed or pest management; may be incorporated as part of an IPM program. Does not provide adequate weed and disease control.	No.
Physical removal/sanitation	Appropriate sanitation practices are already used extensively.	No.
Resistant cultivars	Given the thousands of varieties of ornamentals, developing resistant cultivars for each variety, each with unique pest problems, is not practical. Choices are often market driven.	No.
Soilless culture / Substrates /plug plants	Container production may be possible in higher value cut flower crops but it is not generally feasible, especially for deeper rooted crops and on large acreage.	No.
COMBINATIONS OF ALTERNATIVES		
1,3-Dichloropropene + chloropicrin	This combination provides poorer weed control than methyl bromide.	No.
Dazomet + chloropicrin	Appropriate aeration times, which are dependent on soil temperature, are needed to avoid phytotoxicity (Semer, 1987). In addition, plant back restrictions may cause some growers to be able to grow fewer crops in a year. Weed control is poorer than with methyl bromide (Ragsdale, 2004). Nematodes and weeds are not controlled adequately. Adequate efficacy for the pest complex cannot be achieved with lower use rates.	No.
Metam sodium + chloropicrin	Many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Good disease control can be provided by chloropicrin. However, chloropicrin provides poorer weed control than methyl bromide. In general, weed and nematode control is not adequate with this combination. In addition, these chemicals would have to be applied separately, requiring two applications.	No.

Name of Alternative	Technical and regulatory* reasons for the alternative not being feasible or available	Is the alternative considered cost effective?
Metam sodium + crop rotation	Many years of research have indicated difficulty achieving consistent efficacy with metam sodium on high value crops. Rotation would be to other ornamental crops. In addition, crop rotation is not really a solution to pest problems in floriculture because either the crop cycle is too long (perennials) or the pests persist in the soil for a long time (Pizano, 2001).). Rotations are generally not a true rotation in the pest control sense.	No.

14. List and Discuss Why Registered *(and Potential)* Pesticides and Herbicides Are Considered Not Effective as Technical Alternatives to Methyl Bromide:

Name of Alternative	Discussion
Herbicides and fumigation with methyl bromide, 1,3-D and chloropicrin, metam sodium and chloropicrin	Herbicides are more feasible for perennials if they are registered. Herbicides are often selective and there are a limited number registered. There are liability concerns due to phytotoxicity concerns on ornamentals.
Sodium azide	Preliminary results in a calla trial suggest that sodium azide may not be a feasible alternative in this crop due to reduced crop vigor and increased mortality (Gerik, 2003).

15. List Present *(and Possible Future)* Registration Status of Any Current and Potential Alternatives:

Table 15.1: Present Registration Status of Alternatives

Name of Alternative	Present Registration Status	Registration being considered by national authorities? (Y/N)	Date of possible future registration:
Sodium Azide	Not registered in U. S. No registration package has been received.	No	Unknown
Propargyl bromide	Not registered in U. S. No registration package has been received.	No	Unknown
Iodomethane	Not registered in U. S.	Yes	Unknown
Furfural	Not registered	Yes	Unknown
Muscador albus strain QST 20799	Registration package has been received.	Yes	Registered but not yet for sale in the U.S.

MICHIGAN HERBACEOUS PERENNIALS - 16. STATE RELATIVE EFFECTIVENESS OF RELEVANT ALTERNATIVES COMPARED TO METHYL BROMIDE FOR THE SPECIFIC KEY TARGET PESTS AND WEEDS FOR WHICH IT IS BEING REQUESTED

Currently, limited research is available for herbaceous perennials because long term research with USDA is ongoing. This research is due to be analyzed and reported after 2006 studies end. However, some preliminary research is available and is described below. For additional studies on ornamentals, see data included for California and Florida. These studies are separated by location of the study, but some of the crop species, pests, and other issues are the same.

MICHIGAN HERBACEOUS PERENNIALS – HOSTA – TABLE 16.1: EFFECTIVENESS OF ALTERNATIVES – *INULA BRITTANNICA*

KEY PEST: *INULA BRITTANNICA*	AVERAGE PERCENT WEED CONTROL AND AVERAGE PERCENT CROP INJURY				
METHYL BROMIDE FORMULATIONS AND ALTERNATIVES	# OF REPS	OCTOBER 15, 2001		JUNE 20, 2002	
		Percent Weed Control	**Percent Crop Injury**	**Percent Weed Control**	**Percent Crop Injury**
Triclopyr + clopyralid (1.68 kg ai/ha)	n/a	100	19	89	89
Dicamba (2.24 kg ai/ha)	n/a	100	41	67	78
Clopyralid (0.28 kg ai/ha)	n/a	100	19	67	26
Clopyralid (0.56 kg ai/ha)	n/a	100	22	81	33
2,4-D + clopyralid (1.5 kg ai/ha)	n/a	100	22	78	37
2,4-D (3.36 kg ai/ha)	n/a	97	37	74	56
Triclopyr (2.24 kg ai/ha)	n/a	89	3	70	81
Glyphosate (4.48 kg ai/ha)	n/a	48	41	26	89
Diquat (1.5 kg ai/ha)	n/a	52	97	26	14
Dicamba + diflufenzopyr (0.196 kg ai/ha)	n/a	89	26	8	78
LSD		10	23	30	16

(Richardson, Zandstra, and Dudek)

These herbicides are currently not registered for control of this weed. Some limitations to this study include no methyl bromide control treatment and no data from an untreated control.

TABLE C.1: ALTERNATIVES YIELD LOSS DATA SUMMARY

ALTERNATIVE	LIST TYPE OF PEST	RANGE OF YIELD LOSS (COMPARED TO MB)	BEST ESTIMATE OF YIELD LOSS
Chloropicrin	Fungi	+3% to –13%	5% loss
Metam-sodium	Weeds	+3% to –13%	5% loss
Dazomet	Weeds	+3% to –13%	5% loss
1,3-D	Nematodes, Weeds	+3% to –13%	5% loss
Metam-sodium + chloropicrin	Weeds, Fungi	+5% to –8%	0-3% loss
1,3-D + chloropicrin	Weeds, Fungi	+5% to –8%	0-3% loss
OVERALL LOSS ESTIMATE FOR ALL ALTERNATIVES TO PESTS			3-5%

17. ARE THERE ANY OTHER POTENTIAL ALTERNATIVES UNDER DEVELOPMENT WHICH ARE BEING CONSIDERED TO REPLACE METHYL BROMIDE?

Research is currently being conducted to identify potential alternatives. Please refer to Section 16 and Section 23.

The use of 1,3-D or 1,3-D/chloropicrin under tarp combined with post-emergence herbicides is considered a potential alternative. Some growers have already made the transition to 1,3-D. However, increased research on herbicides, including the evaluation of carryover and phytotoxicity, is needed. In addition, some herbicides may need expanded labeling, which could take time. Iodomethane is also expected to help growers transition away from methyl bromide, although it is unknown when registration might occur. This region expects to have workable alternatives by 2007 or 2008.

18. ARE THERE TECHNOLOGIES BEING USED TO PRODUCE THE CROP WHICH AVOID THE NEED FOR METHYL BROMIDE?:

A number of technologies are currently being used in this sector, including integrated pest management, crop rotation, fallow periods, hand weeding, etc. However, these practices are still not sufficient to control the key target pests without the use of methyl bromide.

SUMMARY OF TECHNICAL FEASIBILITY

This nomination includes requests for MeBr only for those nurseries where sufficient pest control can not be achieved otherwise. While combinations of chemicals, such as 1,3-D + chloropicrin + herbicides appear to be effective for some growers, currently all growers can not rely solely on alternatives.

For example, 1,3-D is an effective nematicide that may have some efficacy against plant pathogens, but for efficacy for weed management additional inputs will be required, such as the use of herbicides. In addition, these alternatives may not be economically feasible.

The industry is continuing to sponsor research on alternatives and to test improved chemical application technologies to increase the efficacy of some of the most viable alternatives. MeBr is considered to be critical in the short-term, with chemical alternatives the likely long-term solution. Non-chemical and biological control methodologies are not adequate to control the key pests. Integration of several alternative treatments is the most likely alternative to MB.

PART D: EMISSION CONTROL

19. TECHNIQUES THAT HAVE AND WILL BE USED TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS IN THE PARTICULAR USE:

TABLE 19.1: TECHNIQUES TO MINIMIZE METHYL BROMIDE USE AND EMISSIONS

TECHNIQUE OR STEP TAKEN	VIF OR HIGH BARRIER FILMS	METHYL BROMIDE DOSAGE REDUCTION	INCREASED % CHLOROPICRIN IN METHYL BROMIDE FORMULATION	LESS FREQUENT APPLICATION
WHAT USE/EMISSION REDUCTION METHODS ARE PRESENTLY ADOPTED?	Currently some growers use HDPE tarps.	Some growers have switched from a 98% MeBr formulation to a 67 % formulation.	Unknown.	Unknown
WHAT FURTHER USE/EMISSION REDUCTION STEPS WILL BE TAKEN FOR THE METHYL BROMIDE USED FOR CRITICAL USES?	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try high density films.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try lowering methyl bromide dosages.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try increasing the chloropicrin percentage.	The U.S. anticipates that the decreasing supply of methyl bromide will motivate growers to try less frequent applications. However, limited grower experience and scientific data suggest current applications are critical for production.
OTHER MEASURES *(please describe)*	Water seals of newer products	Unknown	Unknown	Unknown

20. IF METHYL BROMIDE EMISSION REDUCTION TECHNIQUES ARE NOT BEING USED OR ARE NOT PLANNED FOR THE CIRCUMSTANCES OF THE NOMINATION STATE REASONS

In accordance with the criteria of the critical use exemption, each party is required to describe ways in which it strives to minimize use and emissions of methyl bromide. The use of methyl bromide in ornamental production in the United States is minimized in several ways. First, because of its toxicity, methyl bromide has, for the last 40 years, been regulated as a restricted use pesticide in the United States. As a consequence, methyl bromide can only be used by certified applicators that are trained at handling these hazardous pesticides. In practice, this means that methyl bromide is applied by a limited number of very experienced applicators with the knowledge and expertise to minimize dosage to the lowest level possible to achieve the needed results. In keeping with both local requirements to avoid "drift" of methyl bromide into inhabited areas, as well as to preserve methyl bromide and keep related emissions to the lowest level possible, methyl bromide application is most often machine injected into soil to specific depths.

As methyl bromide has become more scarce, users in the United States have, where possible, experimented with different mixes of methyl bromide and chloropicrin. Specifically, in the early 1990s, methyl bromide was typically sold and used in methyl bromide mixtures made up of 95% methyl bromide and 5% chloropicrin, with the chloropicrin being included solely to give the chemical a smell enabling those in the area to be alerted if there was a risk. However, with the outset of very significant controls on methyl bromide, users have been experimenting with significant increases in the level of chloropicrin and reductions in the level of methyl bromide. While these new mixtures have generally been effective at controlling target pests, at low to moderate levels of infestation, it must be stressed that the long term efficacy of these mixtures is unknown.

Tarpaulin (high density polyethylene) is also used to minimize use and emissions of methyl bromide. In addition, cultural practices are utilized by ornamental growers.

Reduced methyl bromide concentrations in mixtures, cultural practices, and the extensive use of tarpaulins to cover land treated with methyl bromide has resulted in reduced emissions and an application rate that we believe is among the lowest in the world for the uses described in this nomination.

PART E: ECONOMIC ASSESSMENT

(Pull Economics from previous Forest Seedling CUNs?)

Please note that in this study net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation for an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income is smaller than the net revenue measured in this study, often substantially so. We did not include fixed costs because they are difficult to measure and verify.

21. COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD

TABLE 21.1: COSTS OF ALTERNATIVES COMPARED TO METHYL BROMIDE OVER 3-YEAR PERIOD -

REGION	ALTERNATIVE	YIELD*	COST IN YEAR 1 *(U.S.$/ha)*	COST IN YEAR 2 *(U.S.$/ha)*	COST IN YEAR 3 *(U.S.$/ha)*
California Cut Flowers – Calla Lily & Bulbs	**Methyl Bromide**	**100**	**$5,421**	**$5,421**	**$5,421**
	Dazomet	75	$5,421	$5,421	$5,421
	1,3-d + pic	75	$5,421	$5,421	$5,421
	Metam Sodium	80	$5,421	$5,421	$5,421
Florida Cut Flowers - Lilies	**Methyl Bromide**	**100**	**$14,085**	**$14,085**	**$14,085**
	Dazomet	75	$14,085	$14,085	$14,085
	1,3-d + pic	75	$14,085	$14,085	$14,085
	Metam Sodium	80	$14,085	$14,085	$14,085
Florida Cut Flowers - Caladium	**Methyl Bromide**	**100**	**$7,660**	**$7,660**	**$7,660**
	Dazomet	75	$7,660	$7,660	$7,660
	1,3-d + pic	75	$7,660	$7,660	$7,660
	Metam Sodium	80	$7,660	$7,660	$7,660
REGION H - MICHIGAN HERBACEOUS PERENNIALS	**Methyl Bromide**	**100**	**$ 37,311**	**$ 37,311**	**$ 37,311**
	Various Alternatives*	95	$ 58,414	$ 58,414	$ 58,414

**As percentage of typical or 3-year average yield, compared to methyl bromide.*

22. GROSS AND NET REVENUE:

TABLE 22.1: YEAR 1 GROSS AND NET REVENUE

		YEAR 1	
REGION	ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
California Cut Flowers – Calla Lily & Bulbs	**Methyl Bromide**	**$171,286**	**$22,251**
	Dazomet	$128,465	($20,570)
	1,3-d + pic	$128,465	($20,570)
	Metam Sodium	$137,029	($12,006)
Florida Cut Flowers - Lilies	**Methyl Bromide**	**$231,043**	**$71,537**
	Dazomet	$173,283	$13,776
	1,3-d + pic	$173,283	$13,776
	Metam Sodium	$184,835	$25,328
Florida Cut Flowers - Caladium	**Methyl Bromide**	**$27,799**	**$3,459**
	Dazomet	$20,850	($3,490)
	1,3-d + pic	$20,850	($3,490)
	Metam Sodium	$22,239	($2,100)
REGION H - MICHIGAN HERBACEOUS PERENNIALS	**Methyl Bromide**	**$ 140,956**	**$ 103,645**
	Various Alternatives*	$ 133,908	$ 75,494

* The category Various Alternatives includes physical removal and sanitation, the use of artificial media, and soil treatment with 1,3-D +chloropicrin.

TABLE 22.2: YEAR 2 GROSS AND NET REVENUE

YEAR 1			
REGION	ALTERNATIVES *(as shown in question 21)*	GROSS REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*	NET REVENUE FOR LAST REPORTED YEAR *(U.S.$/ha)*
California Cut Flowers – Calla Lily & Bulbs	**Methyl Bromide**	**$171,286**	**$22,251**
	Dazomet	$128,465	($20,570)
	1,3-d + pic	$128,465	($20,570)
	Metam Sodium	$137,029	($12,006)
Florida Cut Flowers - Lilies	**Methyl Bromide**	**$231,043**	**$71,537**
	Dazomet	$173,283	$13,776
	1,3-d + pic	$173,283	$13,776
	Metam Sodium	$184,835	$25,328
Florida Cut Flowers - Caladium	**Methyl Bromide**	**$27,799**	**$3,459**
	Dazomet	$20,850	($3,490)
	1,3-d + pic	$20,850	($3,490)
	Metam Sodium	$22,239	($2,100)
REGION H - MICHIGAN HERBACEOUS PERENNIALS	**Methyl Bromide**	**$ 140,956**	**$ 103,645**
	Various Alternatives*	$ 133,908	$ 75,494

* The category Various Alternatives includes physical removal and sanitation, the use of artificial media, and soil treatment with 1,3-D +chloropicrin.

TABLE 22.3: YEAR 3 GROSS AND NET REVENUE

Year 3			
Region	**Alternatives** *(as shown in question 21)*	**Gross revenue for last reported year** *(U.S.$/ha)*	**Net Revenue for last reported year** *(U.S.$/ha)*
California Cut Flowers – Calla Lily & Bulbs	**Methyl Bromide**	**$171,286**	**$22,251**
	Dazomet	$128,465	($20,570)
	1,3-d + pic	$128,465	($20,570)
	Metam Sodium	$137,029	($12,006)
Florida Cut Flowers - Lilies	**Methyl Bromide**	**$231,043**	**$71,537**
	Dazomet	$173,283	$13,776
	1,3-d + pic	$173,283	$13,776
	Metam Sodium	$184,835	$25,328
Florida Cut Flowers - Caladium	**Methyl Bromide**	**$27,799**	**$3,459**
	Dazomet	$20,850	($3,490)
	1,3-d + pic	$20,850	($3,490)
	Metam Sodium	$22,239	($2,100)
Region H - Michigan Herbaceous Perennials	**Methyl Bromide**	**$ 140,956**	**$ 103,645**
	Various Alternatives*	$ 133,908	$ 75,494

* The category Various Alternatives includes physical removal and sanitation, the use of artificial media, and soil treatment with 1,3-D +chloropicrin.

MEASURES OF ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

TABLE E.1: CALIFORNIA CALLA LILY & BULBS - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

California Cut Flowers – Calla Lily & Bulbs	Methyl Bromide	Dazomet	1,3-D + Pic	Metam Sodium
Yield Loss (%)	0	25 %	25%	20%
Yield per Hectare	236,630	177,473	177,473	189,304
*** Price per Unit (U.S.$)**	$0.72	$0.72	$0.72	$0.72
= Gross Revenue per Hectare (U.S.$)	$171,286	$128,465	$128,465	$137,029
- Operating Costs per Hectare (U.S.$)	$149,035	$149,035	$149,035	$149,035
= Net Revenue per Hectare (U.S.$)	$22,251	($20,570)	($20,570)	($12,006)
1. Loss per Hectare (U.S.$)	$0	$42,822	$42,822	$34,257
2. Loss per Kilogram of Methyl Bromide (U.S.$)	$0	$170	$170	$136
3. Loss as a Percentage of Gross Revenue (%)	0%	25%	25%	20%
4. Loss as a Percentage of Net Revenue (%)	0%	192%	192%	154%

TABLE E.2: FLORIDA CUT FLOWERS - LILIES - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

Florida Cut Flowers - Lilies	Methyl Bromide	Dazomet	1,3-D + Pic	Metam Sodium
Yield Loss (%)	0	25 %	25%	20%
Yield per Hectare	30,806	23,104	23,104	24,645
* Price per Unit (U.S.$)	$7.50	$7.50	$7.50	$7.50
= Gross Revenue per Hectare (U.S.$)	$231,043	$173,283	$173,283	$184835
- Operating Costs per Hectare (U.S.$)	$159,506	$159,506	$159,506	$159,506
= Net Revenue per Hectare (U.S.$)	$71,537	$13,776	$13,776	$25,328
1. Loss per Hectare (U.S.$)	$0	$57,761	$57,761	$46,209
2. Loss per Kilogram of Methyl Bromide (U.S.$)	$0	$131	$131	$105
3. Loss as a Percentage of Gross Revenue (%)	0%	25%	25%	20%
4. Loss as a Percentage of Net Revenue (%)	0%	81%	81%	65%

TABLE E.3: FLORIDA - CALADIUM - ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

Florida - Caladium	Methyl Bromide	Dazomet	1,3-D + Pic	Metam Sodium
Yield Loss (%)	0	25 %	25 %	25 %
Yield per Hectare	111,197	83,398	83,398	88,958
* Price per Unit (U.S.$)	$0.25	$0.25	$0.25	$0.25
= Gross Revenue per Hectare (U.S.$)	$27,799	$20,850	$20,850	$22,239
- Operating Costs per Hectare (U.S.$)	$24,340	$24,340	$24,340	$24,340
= Net Revenue per Hectare (U.S.$)	$3,459	($3,490)	($3,490)	($2,100)
1. Loss per Hectare (U.S.$)	$0	$6,950	$6,950	$5,560
2. Loss per Kilogram of Methyl Bromide (U.S.$)	$0	$23	$23	$19
3. Loss as a Percentage of Gross Revenue (%)	0%	25%	25%	20%
4. Loss as a Percentage of Net Revenue (%)	0%	201%	201%	161%

TABLE E.4: ECONOMIC IMPACTS OF METHYL BROMIDE ALTERNATIVES

Michigan Herbaceous Perennials	Methyl Bromide	Various Alternatives**
Yield Loss (%)	**0%**	**5%**

Yield per Hectare Conifer Seedlings	**144,920**	**137,674**
*** Price per Unit (U.S. $/seedling)**	**$ 0.97**	**$ 0.97**
= Gross Revenue per Proportion (60%)	**$ 140,956**	**$ 133,908**
- Operating Cost per Hectare (U.S. $)	**$ 37,311**	**$ 58,414**
= Net Revenue per Hectare (U.S. $)	**$ 103,645**	**$ 75,494**
Loss Measures		
1. Loss per Hectare (U.S. $)	**$0**	**$ 28,151**
2. Loss per Kilogram of Methyl Bromide (U.S. $)	**$0**	**$ 143.52**
3. Loss as a Percentage of Gross Revenue (%)	**0%**	**21%**
4. Loss as a Percentage of Net Revenue (%)	**0%**	**37%**

** The category Various Alternatives includes physical removal and sanitation, the use of artificial media, and soil treatment with 1,3-D +chloropicrin.

SUMMARY OF ECONOMIC FEASIBILITY

The economic analysis evaluated methyl bromide alternative control scenarios for cut flower production for Florida, California, and Michigan by comparing the economic outcomes of methyl bromide oriented production systems to those using alternatives. However, due to the fact that there are over 100 species of ornamentals grown in all regions of the country, the data from these xamples are used to derive a proxy estimate for the entire industry.

The economic factors that most influence the feasibility of methyl bromide alternatives for fresh cut flower production are: (1) yield losses, referring to reductions in the quantity produced, (2) increased production costs, which may be due to the higher-cost of using an alternative, additional pest control requirements, and/or resulting shifts in other production or harvesting practices, and (3) missed market windows due to plant back time restrictions, which also affect the quantity and price received for the goods.

The economic reviewers analyzed crop budgets for pre-plant sectors to determine the likely economic impact if methyl bromide were unavailable. Various measures were used to quantify the impacts, including the following:

(1) **Loss per Hectare.** For crops, this measure is closely tied to income. It is relatively easy to measure, but may be difficult to interpret in isolation.

(2) **Loss per Kilogram of Methyl Bromide**. This measure indicates the nominal marginal value of methyl bromide to crop production.

(3) **Loss as a Percentage of Gross Revenue.** This measure has the advantage that gross revenues are usually easy to measure, at least over some unit, *e.g.*, a hectare of land or a storage operation. However, high value commodities or crops may provide high revenues but may also entail high costs. Losses of even a small percentage of gross revenues could have important impacts on the profitability of the activity.

(4) **Loss as a Percentage of Net Operating Revenue**. We define net cash revenues as gross revenues minus operating costs. This is a very good indicator as to the direct losses of income

that may be suffered by the owners or operators of an enterprise. However, operating costs can often be difficult to measure and verify.

(5) **Operating Profit Margin**. We define operating profit margin to be net operating revenue divided by gross revenue per hectare. This measure would provide the best indication of the total impact of the loss of methyl bromide to an enterprise. Again, operating costs may be difficult to measure and fixed costs even more difficult, therefore fixed costs were not included in the analysis.

These measures represent different ways to assess the economic feasibility of methyl bromide alternatives for methyl bromide users, who are producers in this case. Because producers (suppliers) represent an integral part of any definition of a market, we interpret the threshold of significant market disruption to be met if there is a significant impact on commodity suppliers using methyl bromide. The economic measures provide the basis for making that determination.

Several methodological approaches will help interpret the findings. Economic estimates were first calculated in pounds and acres and then converted to kilograms and hectares. Costs for alternatives are based on market prices for the control products multiplied by the number of pounds of active ingredient that would be applied. Baseline costs were based on the average number of annual applications necessary to treat cut flowers with methyl bromide.

Net revenue is calculated as gross revenue minus operating costs. This is a good measure as to the direct losses of income that may be suffered by the users. It should be noted that net revenue does not represent net income to the users. Net income, which indicates profitability of an operation of an enterprise, is gross revenue minus the sum of operating and fixed costs. Net income should be smaller than the net revenue measured in this study. Fixed costs were not included because they are difficult to measure and verify.

Loss per hectare measures the value of methyl bromide based on changes in operating costs and/or changes in yield. Loss expressed as a percentage of the gross revenue is based on the ratio of the revenue loss to the gross revenue. Likewise for the loss as a percentage of net revenue. The profit margin percentage is the ratio of net revenue to gross revenue per hectare. The values to estimate gross revenue and the operating costs for each alternative were derived for three alternative control scenarios for Florida and California, relative to methyl bromide: 1) Dazomet; 2) 1,3-d + chloropicrin; and 3) metam sodium. Yield loss estimates were based on data from the CUE's and U.S. EPA data, as well as expert opinion.

Regulatory constraints.
In California, 1,3-d plus chloropicrin would also be the primary replacement for methyl bromide. California restricts total use of 1,3-d, at the local level (township cap). In Florida, the use of 1,3-d also requires a 100-foot buffer around inhabited structures. This would reduce the production acreage an estimated 10%. Nematodes and weeds and pathogens are key pests in Florida and California bulb grower and are controlled with methyl bromide. Chloropicrin is not as effective in controlling weeds as methyl bromide. Using chloropicrin adds to production costs through increased chemical, weeding and labor costs.

Tables E.1 - E.4 provides a summary of the estimated economic losses. A measure of net revenue loss may not be completely accurate partly because some nurseries are publicly owned and seedling prices or production costs are subsidized. The range of losses in the studies is rather large because both dazomet and metam-sodium provide inconsistent pest control. Indirect losses arising from shifts in the production cycle were not quantified. Changes in production costs arise due to differences between the costs of methyl bromide and the alternatives, shifts in the production cycle (increasing the frequency of fumigation or lengthening the fallow period) and additional expenses such as supplementary irrigation. These costs vary across regions

Michigan Herbaceous Perennials

Michigan herbaceous perennials, labeled Region H above, comprise three categories of production systems with numerous plant varieties grown within each category. These categories are 2-year seeded (6% of plants), 2-year transplanted (29% of plants), and 3-year transplanted (65% of plants). To represent growing conditions on a typical hectare of production, and to account for the fact that each category has different revenues and costs of production, the above measures were calculated using representative revenues and costs for each category; these were weighted by the proportion of total production. In addition, various combinations of alternative pest control measures would need to be employed to accomplish the most effective and lowest cost pest control without MB. These various alternative pest control measures include physical removal and sanitation, the use of artificial media, and soil treatment with 1,3-D +chloropicrin.

Note: Market price data was not available for the United States cut flower industry but it is assumed that the net effect of shifting from methyl bromide to any of the alternatives other than metam sodium would result in additional revenue reductions due to fluctuations in market price due to changes in production and harvesting times.

It should be noted that the applicants do not consider any alternative to be feasible and that these estimates are an attempt to measure potential impacts.

PART F. FUTURE PLANS

23. WHAT ACTIONS WILL BE TAKEN TO RAPIDLY DEVELOP AND DEPLOY ALTERNATIVES FOR THIS CROP?

Between 1992 and 2003, the California Cut Flower Commission has spent $260,000 in research related to methyl bromide alternatives in addition to hundreds of thousands of dollars spent by individual growers trying to find workable alternatives. In 2004, $90,000 was spent on research and $100,000 was spent in 2005. One researcher was recently warded $322,000 to continue research on methyl bromide alternatives in the California ornamentals industry. Future research will focus on the following pests: weeds, *Fusarium oxysporum*, *Pythium* spp., *Meloidogyne* spp., and previous crop debris, such as bulblets, cormlets, etc. from crops such as callas, caladiums, and gladiolus. 1,3-D, metam sodium, dazomet, chloropicrin, sodium azide, and iodomethane have already been tested. Future research will focus on iodomethane, combinations of 1,3-D, metam sodium, and chloropicrin.

In Florida, research trials for 2003 are in place for caladiums in muck, aster, and snapdragons, and caladiums in sand are planned for 2004. Several alternatives will be tested, including metam sodium, 1,3-D/chloropicrin, iodomethane/chloropicrin, and sodium azide. Research, including projects on *Celosia* and DMDS, is ongoing.

The Michigan Field Grown Herbaceous Perennial Growers Association is currently assisting in field trials with Michigan State University in research supported in part by the USDA MeBr Alternatives Grant Program. For 2002-2004, $68,979 has been allocated and $370,701 has been granted for a study that runs from 2003-2006. This work is a large investment in identifying alternatives for Michigan growers.

The Agricultural Research Service (United States Department of Agriculture) has two full time employees (since 2000) working on methyl bromide alternatives for flowers and ornamentals. This represents about a $600,000 annual investment. In addition, a recent grant and other money, about $100,000 has provided two CCC grants for flower alternatives.

The amount of methyl bromide requested for research purposes is considered critical for the development of effective alternatives. Without methyl bromide for use as a standard treatment, the research studies can never address the comparative performance of alternatives. This would be a serious impediment to the development of alternative strategies. The U.S. government estimates that ornamentals research will require ??? kg per year of methyl bromide for 2008?. This amount of methyl bromide is necessary to conduct research on alternatives and is in addition to the amounts requested in the submitted CUE applications. One example of the research is a five year field study testing the comparative performance of methyl bromide, 1,3-D, metam sodium, and new reduced risk chemicals for control of soilborne pests with emphasis on nematodes and weeds.

24. HOW DO YOU PLAN TO MINIMIZE THE USE OF METHYL BROMIDE FOR THE CRITICAL USE IN THE FUTURE?

See Section 23 above.

25. ADDITIONAL COMMENTS ON THE NOMINATION?

The MeBr critical use exemption nomination for Ornamentals Seedlings has been reviewed by the U. S. Environmental Protection Agency and the U. S. Department of Agriculture and meets the guidelines of The *Montreal Protocol on Substances That Deplete the Ozone Layer*. This nomination includes requests for MeBr only for those ornamental operations where sufficient pest control can not be achieved otherwise.

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APPENDIX A. 2008 Methyl Bromide Usage Numerical Index (BUNI).

2008 Methyl Bromide Usage Newer Numerical Index - BUNNIE						Ornamentals	
January 24, 2006	Region		CA Cut Flower Commission	Michigan Herbaceous Perennials	FL Cut Flowers	Sector Total or Average	Notes
Dichotomous Variables	Strip or Bed Treatment?		No	No	No		
	Currently Use Alternatives?		Yes	Yes	Yes		
	Tarps / Deep Injection Used?		Tarps	Tarps	Tarps		
	Pest-free Cert Requirements?		No	No	No		
Other Issues	Frequency of Treatment (x/ yr)		1x/ year	1x/ year	1x/ year		*
	QPS Removed?		Yes	Yes	Yes		
Most Likely Combined Impacts (%)	Karst -1,3-D Limitation (%)		0%	0%	40%		
	100 ft Buffer Zones (%)		0%	0%	0%		
	Key Pest Distribution (%)		100%	100%	100%		
	Regulatory Issues (%)		25%	0%	0%		
	Unsuitable Terrain (%)		0%	0%	0%		
	Cold Soil Temperature (%)		0%	0%	0%		
	Total Combined Impacts (%)		**100%**	**100%**	100%		
Most Likely Baseline Transition	(%) Able to Transition		0%	0%	0%		
	Minimum # of Years Required		0	0	0		
	(%) Able to Transition / Year		**0%**	**0%**	**0%**		
EPA Adjusted Use Rate (kg/ha)			211	260	350		
EPA Adjusted Strip Dosage Rate (g/m2)			21	26	35		
2008 Requested Usage	*Amount - Pounds*	*Pounds*	*450,000*	*10,500*	*1,372,000*	*1,832,500*	
	Area - Acres		*2,000*	*30*	*3,500*	*5,530*	
	Rate (lb/A)		*225.00*	*350.00*	*392.00*	*331*	
	Amount - Kilograms	Metric	**204,116**	**4,763**	**622,328**	**831,207**	
	Treated Area - Hectares		809	12	1,416	2,238	
	Rate (kg/ha)		252	392	439	371	
EPA Preliminary Value		**kgs**	**204,116**	**4,763**	**79,379**	**288,257**	
EPA Baseline Adjusted Value has been adjusted for:			MBTOC Adjustments, QPS, Double Counting, Growth, Use Rate/Strip Treatment, Miscellaneous, and Combined Impacts				
EPA Baseline Adjusted Value		kgs	67,946	3,300	63,232	134,478	
EPA Transition Amount		kgs	-	-	-	-	
Most Likely Impact Value (kgs)		kgs	**67,946**	**3,300**	**63,232**	**134,478**	
		ha	**323**	**13**	**181**	**516**	
		Rate	**211**	**260**	**350**	**261**	
Sector Research Amount (kgs)			**4,060**	**2008 Total US Sector Nomination**		**138,538**	

1 Pound = 0.453592 kgs   1 Acre = 0.404686 ha

Footnotes for Appendix A:

Values may not sum exactly due to rounding.

1. **Dichotomous Variables** – dichotomous variables are those which take one of two values, for example, 0 or 1, yes or no. These variables were used to categorize the uses during the preparation of the nomination.
2. **Strip Bed Treatment** – Strip bed treatment is 'yes' if the applicant uses such treatment, no otherwise.
3. **Currently Use Alternatives** – Currently use alternatives is 'yes' if the applicant uses alternatives for some portion of pesticide use on the crop for which an application to use methyl bromide is made.
4. **Tarps/ Deep Injection Used** – Because all pre-plant methyl bromide use in the US is either with tarps or by deep injection, this variable takes on the value 'tarp' when tarps are used and 'deep' when deep injection is used.
5. **Pest-free cert. Required** - This variable is a 'yes' when the product must be certified as 'pest-free' in order to be sold
6. **Other Issues**.- Other issues is a short reminder of other elements of an application that were checked

7. **Frequency of Treatment** – This indicates how often methyl bromide is applied in the sector. Frequency varies from multiple times per year to once in several decades.
8. **Quarantine and Pre-Shipment Removed?** – This indicates whether the Quarantine and pre-shipment (QPS) hectares subject to QPS treatments were removed from the nomination.
9. **Most Likely Combined Impacts (%)** – Adjustments to requested amounts were factors that reduced to total amount of methyl bromide requested by factoring in the specific situations were the applicant could use alternatives to methyl bromide. These are calculated as proportions of the total request. We have tried to make the adjustment to the requested amounts in the most appropriate category when the adjustment could fall into more than one category.
10. **(%) Karst geology** – Percent karst geology is the proportion of the land area in a nomination that is characterized by karst formations. In these areas, the groundwater can easily become contaminated by pesticides or their residues. Regulations are often in place to control the use of pesticide of concern. Dade County, Florida, has a ban on the use of 1,3D due to its karst geology.
11. **(%) 100 ft Buffer Zones** – Percentage of the acreage of a field where certain alternatives to methyl bromide cannot be used due the requirement that a 100 foot buffer be maintained between the application site and any inhabited structure.
12. **(%) Key Pest Impacts** - Percent (%) of the requested area with moderate to severe pest problems. Key pests are those that are not adequately controlled by MB alternatives. For example, the key pest in Michigan peppers, *Phytophthora* spp. infests approximately 30% of the vegetable growing area. In southern states the key pest in peppers is nutsedge.
13. **Regulatory Issues (%)** - Regulatory issues (%) is the percent (%) of the requested area where alternatives cannot be legally used (e.g., township caps) pursuant to state and local limits on their use.
14. **Unsuitable Terrain (%)** – Unsuitable terrain (%) is the percent (%) of the requested area where alternatives cannot be used due to soil type (e.g., heavy clay soils may not show adequate performance) or terrain configuration, such as hilly terrain. Where the use of alternatives poses application and coverage problems.
15. **Cold Soil Temperatures** – Cold soil temperatures is the proportion of the requested acreage where soil temperatures remain too low to enable the use of methyl bromide alternatives and still have sufficient time to produce the normal (one or two) number of crops per season or to allow harvest sufficiently early to obtain the high prices prevailing in the local market at the beginning of the season.
16. **Total Combined Impacts (%)** - Total combined impacts are the percent (%) of the requested area where alternatives cannot be used due to key pest, regulatory, soil impacts, temperature, etc. In each case the total area impacted is the conjoined area that is impacted by any individual impact. The effects were assumed to be independently distributed unless contrary evidence was available (e.g., affects are known to be mutually exclusive). For example, if 50% of the requested area had moderate to severe key pest pressure and 50% of the requested area had karst geology, then 75% of the area was assumed to require methyl bromide rather than the alternative. This was calculated as follows: 50% affected by key pests and an additional 25% (50% of 50%) affected by karst geology.
17. **Most Likely Baseline Transition** – Most Likely Baseline Transition amount was determined by the DELPHI process and was calculated by determining the maximum share of industry that can transition to existing alternatives.
18. **(%) Able to Transition** – Maximum share of industry that can transition
19. **Minimum # of Years Required** – The minimum number of years required to achieve maximum transition.
20. **(%) Able to Transition per Year** – The Percent Able to Transition per Year is the percent able to transition divided by the number of years to achieve maximum transition.
21. **EPA Adjusted Use Rate** - Use rate is the lower of requested use rate for 2008 or the historic average use rate or is determined by MBTOC recommended use rate reductions.
22. **EPA Adjusted Strip Dosage Rate** – The dosage rate is the use rate within the strips for strip / bed fumigation.
23. **2008 Amount of Request** – The 2008 amount of request is the actual amount requested by applicants given in total pounds active ingredient of methyl bromide, total acres of methyl bromide use, and application rate in pounds active ingredient of methyl bromide per acre. U.S. units of measure were used to describe the initial request and then were converted to metric units to calculate the amount of the US nomination.
24. **EPA Preliminary Value** – The EPA Preliminary Value is the lowest of the requested amount from 2005 through 2008 with MBTOC accepted adjustments (where necessary) included in the preliminary value.
25. **EPA Baseline Adjusted Value** – The EPA Baseline Adjusted Value has been adjusted for MBTOC adjustments, QPS, Double Counting, Growth, Use Rate/ Strip Treatment, Miscellaneous adjustments, MBTOC recommended Low Permeability Film Transition adjustment, and Combined Impacts.

26. **EPA Transition Amount** – The EPA Transition Amount is calculated by removing previous transition amounts since transition was introduced in 2007 and removing the amount of the percent (%) Able to Transition per Year multiplied by the EPA Baseline Adjusted Value.
27. **Most Likely Impact Value** – The qualified amount of the initial request after all adjustments have been made given in total kilograms of nomination, total hectares of nomination, and final use rate of nomination.
28. **Sector Research Amount** – The total U.S. amount of methyl bromide needed for research purposes in each sector.
29. **Total US Sector Nomination** - Total U.S. sector nomination is the most likely estimate of the amount needed in that sector.

APPENDIX B – KEY PESTS OF SELECT CUT FLOWER SPECIES

The following list is not comprehensive, but is intended to demonstrate the complexity of the industry. In addition to the diseases and nematodes listed below, there are numerous weed species that are major problems in cut flower production. These species include the bulbs, tubers, or cormlets from a previous crop, yellow nutsedge (*Cyperus esculentus*), little mallow (*Malva parviflora*), and common sow thistle (*Sonchus oleracea*).

Diseases and Nematodes of cut flower crops currently controlled with Methyl Bromide.

Crop	Key Pests	Scientific name
Antirrhinum	Nematodes Pythium root rot	*Belanolaimus longidorus, Criconomella* spp., *Dolichodorus heterocephalus* *Pythium irregulare* (documented resistance to mefenoxam is 25-50%)
Calla lily	Erwinia soft rot Pythium root rot	*Erwinia carotovora* *Pythium* spp. (resistance to mefenoxam suspected to be widespread
Delphinium	Sclerotinia stem rot	*Sclerotinia* spp.
Dianthus	Fusarium wilt	*Fusarium oxysporum* fsp. *dianthii*
Eustoma	Fusarium wilt, root rot, and stem rot	*Fusarium oxysporum, F. solani,* and *F. avenaceaum*
Freesia	Fusarium wilt	*Fusarium* spp.
Gladiolus	Fusarium wilt Stromatinia neck rot	*Fusarium oxysporum* fsp. *gladioli* *Stromatinia gladioli*
Helianthus	Downy mildew	*Plasmopara halstedii* (this is a soil-borne pathogen)
Hypericum	Root knot nematode Pythium root rot	*Meloidogyne* spp. *Pythium* spp.
Iris	Fusarium wilt	*Fusarium oxysporum* fsp. *iridis*
Larkspur	Sclerotinia stem rot	*Sclerotinia sclerotiorum*
Liatris spicata	Sclerotinia stem rot	*Sclerotinia sclerotiorum*
Lilium	Pythium root rot	*Pythium* spp.
Matthiola	Sclerotinia stem rot Xanthomonas leaf spot	*Sclerotinia sclerotiorum* *Xanthomonas campestris* pv. *campestris*
Ranunculus	Pythium root rot Xanthomonas leaf spot	*Pythium* spp. *Xanthomonas campestris*